Form No. DTMB-3522 (Rev. 10/2015)
AUTHORITY: Act 431 of 1984
COMPLETION: Required
PENALTY: Contract change will not be executed unless form is filed

STATE OF MICHIGAN

DEPARTMENT OF TECHNOLOGY, MANAGEMENT & BUDGET

PROCUREMENT

525 W. ALLEGAN STREET
LANSING, MI 48933

P.O. BOX 30026
LANSING, MI 48909

NOTICE OF CONTRACT NO. **071B6600018**

Between

THE STATE OF MICHIGAN

And

NAME & ADDRESS OF CONTRACTOR	PRIMARY CONTACT	EMAIL
3M Company **3M Center-Building 225-4N-14** **St. Paul, MN 55144-1000**	**Dan Moran**	**dfmoran@mmm.com**
	PHONE	**VENDOR TAX ID # (LAST FOUR DIGITS ONLY)**
	800-553-1380 #3	**7775**

STATE CONTACTS	AGENCY	NAME	PHONE	EMAIL
PROGRAM MANAGER	MDOC MDNR MDOT	Cathy Carr Ruth Thole Justin Droste	517-241-2192 517-335-1553 517-636-0581	carrc@michigan.gov tholer@michigan.gov drostej@michigan.gov
CONTRACT ADMINISTRATOR	DTMB	Steve Rigg	517-284-7043	riggs@michigan.gov

CONTRACT SUMMARY

DESCRIPTION:

Reflective Sheeting and Traffic Marking Tape

INITIAL TERM	EFFECTIVE DATE	INITIAL EXPIRATION DATE	AVAILABLE OPTIONS
3 years	January 26, 2016	January 25, 2019	3 – 3 year options
PAYMENT TERMS	**F.O.B.**	**SHIPPED TO**	
2% 20 / NET 30	Shipping Point	Various locations	

ALTERNATE PAYMENT OPTIONS	EXTENDED PURCHASING
☒ P-card ☐ Direct Voucher (DV) ☐ Other	☒ Yes ☐ No

MINIMUM DELIVERY REQUIREMENTS

1 unit

MISCELLANEOUS INFORMATION

ESTIMATED CONTRACT VALUE AT TIME OF EXECUTION	$6,266,355.48

For the Contractor:

_____ _____

Daniel F. Moran,
TSSD Lead Contract Administrator
3M

Date

For the State:

_____ _____

Sharon Walenga-Maynard
Sourcing Director
State of Michigan

Date

STATE OF MICHIGAN

STANDARD CONTRACT TERMS

This STANDARD CONTRACT ("**Contract**") is agreed to between the **State of Michigan** (the "**State**") and **3M Company** ("**Contractor**"), a Delaware corporation. This Contract is effective on **January 26, 2016** ("**Effective Date**"), and unless terminated, expires on **January 25, 2019**.

This Contract may be renewed for up to **three (3) additional three (3) year period(s)**. Renewal must be by mutual written agreement of the parties, not less than 30 days before expiration of the Contract.

The parties agree as follows:

1. **Duties of Contractor.** Contractor must perform the services and provide the deliverables described in **Exhibit A-1 – Statement of Work for License Plate Reflective Sheeting** and **Exhibit A-2 Statement of Work for Road Sign Reflective Sheeting and Pavement Markers** (the "**Contract Activities**"). An obligation to provide delivery of any commodity is considered a service and is a Contract Activity.

   Contractor must furnish all labor, equipment, materials, and supplies necessary for the performance of the Contract Activities, and meet operational standards, unless otherwise specified in **Exhibit A-1 – Statement of Work for License Plate Reflective Sheeting** and **Exhibit A-2 Statement of Work for Road Sign Reflective Sheeting and Pavement Markers**.

   Contractor must: (a) perform the Contract Activities in a timely, professional, safe, and workmanlike manner consistent with standards in the trade, profession, or industry; (b) meet or exceed the performance and operational standards, and specifications of the Contract; (c) provide all Contract Activities in good quality, with no material defects; (d) not interfere with the State's operations; (e) obtain and maintain all necessary licenses, permits or other authorizations necessary for the performance of the Contract; (f) cooperate with the State, including the State's quality assurance personnel, and any third party to achieve the objectives of the Contract; (g) return to the State any State-furnished equipment or other resources in the same condition as when provided when no longer required for the Contract; (h) not make any media releases without prior written authorization from the State; (i) assign to the State any material claims resulting from state or federal antitrust violations to the extent that those violations concern materials or services supplied by third parties toward fulfillment of the Contract; (j) comply with all State physical and IT security policies and standards which will be made available upon request; and (k) provide the State priority in performance of the Contract except as mandated by federal disaster response requirements. Any breach under this paragraph is considered a material breach.

   Contractor must also be clearly identifiable while on State property by wearing identification issued by the State, and clearly identify themselves whenever making contact with the State.

2. **Notices.** All notices and other communications required or permitted under this Contract must be in writing and will be considered given and received: (a) when verified by written receipt if sent by courier; (b) when actually received if sent by mail without verification of receipt; or (c) when verified by automated receipt or electronic logs if sent by facsimile or email.

If to State:	If to Contractor:
Steve Rigg Constitution Hall 525 W. Allegan St, 1st Floor, NE P.O. Box 30026 Lansing, MI 48909 riggs@michigan.gov	Dan Moran 3M TSSD Lead Contract Administrator 3M Center, 225-4N-14 St. Paul, MN 55144 dfmoran@mmm.com

3. **Contract Administrator.** The Contract Administrator for each party is the only person authorized to modify any terms of this Contract, and approve and execute any change under this Contract (each a "**Contract Administrator**"):

State:	Contractor:
Steve Rigg - Constitution Hall 525 W. Allegan St, 1st Floor, NE P.O. Box 30026 Lansing, MI 48909 riggs@michigan.gov	Dan Moran 3M TSSD Lead Contract Administrator 3M Center, 225-4N-14 St. Paul, MN 55144 dfmoran@mmm.com

4. **Program Manager.** The Program Manager for each party will monitor and coordinate the day-to-day activities of the Contract (each a "**Program Manager**"):

State:	Contractor:
See Contract cover sheet or most recent change notice for current program manager.	Dan Moran 3M TSSD Lead Contract Administrator 3M Center, 225-4N-14 St. Paul, MN 55144 dfmoran@mmm.com

5. **Performance Guarantee**. Contractor must at all times have financial resources sufficient, in the opinion of the State, to ensure performance of the Contract and must provide proof upon request. The State may require a performance bond if, in the opinion of the State, it will ensure performance of the Contract.

6. **Insurance Requirements.** Contractor must maintain the insurances identified below and is responsible for all deductibles. All required insurance must: (a) protect the State from claims that arise directly out of, or result directly from Contractor's negligent performance; (b) be primary and non-contributing to any comparable liability insurance (including self-insurance) carried by the State; and (c) be provided by a company with an A.M. Best rating of "A" or better, and a financial size of VII or better.

Required Limits	Additional Requirements
Commercial General Liability Insurance	
Minimal Limits: $1,000,000 Each Occurrence Limit $1,000,000 Personal & Advertising Injury Limit $2,000,000 General Aggregate Limit $2,000,000 Products/Completed Operations Deductible Maximum: $50,000 Each Occurrence	Contractor must have their policy endorsed to add "the State of Michigan, its departments, divisions, agencies, offices, commissions, officers, employees, and agents" as additional insureds using endorsement CG 20 10 11 85, or both CG 2010 07 04 and CG 2037 07 0 or equivalent.
Automobile Liability Insurance	
Minimal Limits: $1,000,000 Per Occurrence	Contractor must have their policy: (1) endorsed to add "the State of Michigan, its departments, divisions, agencies, offices, commissions, officers, employees, and agents" as additional insureds; and (2) include Hired and Non-Owned Automobile coverage.
Workers' Compensation Insurance	
Minimal Limits: Coverage according to applicable laws governing work activities.	Waiver of subrogation, except where waiver is prohibited by law.
Employers Liability Insurance	
Minimal Limits: $500,000 Each Accident $500,000 Each Employee by Disease $500,000 Aggregate Disease.	

If any of the required policies provide **claims-made** coverage, the Contractor must: (a) provide coverage with a retroactive date before the effective date of the contract or the beginning of Contract Activities; (b) maintain coverage and provide evidence of coverage for at least three (3) years after completion of the Contract Activities; and (c) if coverage is canceled or not renewed, and not replaced with another claims-made policy form with a retroactive date prior to the contract effective date, Contractor must purchase extended reporting coverage for a minimum of three (3) years after completion of work.

Contractor must: (a) provide insurance certificates to the Contract Administrator, containing the agreement or purchase order number, at Contract formation and within 20 calendar days of the expiration date of the applicable policies; (b) require that subcontractors maintain the required insurances contained in this Section; (c) notify the Contract Administrator within 5

business days if any insurance is cancelled; and (d) waive all rights against the State for damages covered and paid by insurance. Failure to maintain the required insurance does not limit this waiver.

This Section is not intended to and is not to be construed in any manner as waiving, restricting or limiting the liability of either party for any obligations under this Contract (including any provisions hereof requiring Contractor to indemnify, defend and hold harmless the State).

7. **Administrative Fee and Reporting.** Contractor must pay an administrative fee of **1%** on all payments made to Contractor under the Contract including transactions with MiDEAL members, and other states (including governmental subdivisions and authorized entities). Administrative fee payments must be made by check payable to the State of Michigan and mailed to:

Department of Technology, Management and Budget
Financial Services – Cashier Unit
Lewis Cass Building
320 South Walnut St.
P.O. Box 30681
Lansing, MI 48909

Contractor must submit an itemized purchasing activity report, which includes at a minimum, the name of the purchasing entity and the total dollar volume in sales. Reports should be mailed to DTMB-Procurement.

The administrative fee and purchasing activity report are due within 30 calendar days from the last day of each calendar quarter.

8. **Extended Purchasing Program.** This contract is extended to MiDEAL members. MiDEAL members include local units of government, school districts, universities, community colleges, and nonprofit hospitals. A current list of MiDEAL members is available at www.michigan.gov/mideal. Upon mutual written agreement between the State and Contractor, this contract may also be extended to: (a) State of Michigan employees and (b) other states (including governmental subdivisions and authorized entities).

If extended, Contractor must supply all Contract Activities at the established Contract prices and terms, and the State reserves the right to impose an administrative fee and negotiate additional discounts based on any increased volume generated by such extensions.

Contractor must submit invoices to, and receive payment from, extended purchasing program members on a direct and individual basis.

9. **Independent Contractor.** Contractor is an independent contractor and assumes all rights, obligations and liabilities set forth in this Contract. Contractor, its employees, and agents will not be considered employees of the State. No partnership or joint venture relationship is created by virtue of this Contract. Contractor, and not the State, is responsible for the payment of wages, benefits and taxes of Contractor's employees and any subcontractors. Prior performance does not modify Contractor's status as an independent contractor.

10. **Subcontracting.** Contractor may not delegate any of its obligations under the Contract without the prior written approval of the State. Contractor must notify the State at least 90 calendar days before the proposed delegation, and provide the State any information it requests to determine whether the delegation is in its best interest. If approved, Contractor must: (a) be the sole point of contact regarding all contractual matters, including payment and charges for all Contract Activities; (b) make all payments to the subcontractor; and (c) incorporate the terms and conditions contained in this Contract in any subcontract with a subcontractor. Contractor remains responsible for the completion of the Contract Activities, compliance with the terms of this Contract, and the acts and omissions of the subcontractor. The State, in its sole discretion, may require the replacement of any subcontractor.

11. **Staffing.** The State's Contract Administrator may require Contractor to remove or reassign personnel by providing a notice to Contractor.

12. **Background Checks.** Upon request, Contractor must perform background checks on all employees and subcontractors and its employees prior to their assignment. The scope will be determined by the parties and documentation must be provided as requested. Contractor is responsible for all costs associated with the requested background checks. The State, in its sole discretion, may also perform background checks.
13. **Assignment.** Contractor may not assign this Contract to any other party without the prior approval of the State. Upon notice to Contractor, the State may assign in whole or in part, its rights or responsibilities under this Contract to any other party. If the State determines that a novation of the Contract to a third party is necessary, Contractor will agree to the novation and provide all necessary documentation and signatures.

14. **Change of Control.** Contractor will notify, at least 90 calendar days before the effective date, the State of a change in Contractor's organizational structure or ownership. For purposes of this Contract, a change in control means any of the following: (a) a sale of more than 50% of Contractor's stock; (b) a sale of substantially all of Contractor's assets; (c) a change in a majority of Contractor's board members; (d) consummation of a merger or consolidation of Contractor with any other

entity; (e) a change in ownership through a transaction or series of transactions; (f) or the board (or the stockholders) approves a plan of complete liquidation. A change of control does not include any consolidation or merger effected exclusively to change the domicile of Contractor, or any transaction or series of transactions principally for bona fide equity financing purposes.

In the event of a change of control, Contractor must require the successor to assume this Contract and all of its obligations under this Contract.

15. **Ordering.** Contractor is not authorized to begin performance until receipt of authorization as identified in Exhibit A-1 and Exhibit A-2.

16. **Acceptance.** Contract Activities are subject to inspection and testing by the State within 30 calendar days of the State's receipt of them ("**State Review Period**"), unless otherwise provided in Exhibit A. If the Contract Activities are not fully accepted by the State, the State will notify Contractor by the end of the State Review Period that either: (a) the Contract Activities are accepted, but noted deficiencies must be corrected; or (b) the Contract Activities are rejected. If the State finds material deficiencies, it may: (i) reject the Contract Activities without performing any further inspections; (ii) enforce Contractor's warranty provisions as specifically stated in the product bulletins submitted with Contractor's Request for Proposal response (see ***"Attachment B - 3M Product Bulletins for Reflective Sheeting and Pavement Marking Tape***"); or (iii) terminate this Contract in accordance with Section 23, Termination for Cause.
Within 10 business days from the date of Contractor's receipt of notification of acceptance with deficiencies or rejection of any Contract Activities, Contractor must cure, at no additional cost, the deficiency and deliver unequivocally acceptable Contract Activities to the State. If acceptance with deficiencies or rejection of the Contract Activities impacts the content or delivery of other non-completed Contract Activities, the parties' respective Program Managers must determine an agreed to number of days for re-submission that minimizes the overall impact to the Contract. However, nothing herein affects, alters, or relieves Contractor of its obligations to correct deficiencies in accordance with the time response standards set forth in this Contract.

If Contractor is unable or refuses to correct the deficiency within the time response standards set forth in this Contract, the State may cancel the order in whole or in part. The State, or a third party identified by the State, may perform the Contract Activities and recover the difference between the cost to cure and the Contract price plus an additional 10% administrative fee.

17. **Delivery.** Contractor must deliver all Contract Activities F.O.B. destination, within the State premises with transportation and handling charges paid by Contractor, unless otherwise specified in Exhibit A. All containers and packaging becomes the State's exclusive property upon acceptance.

18. **Risk of Loss and Title.** Until final acceptance, title and risk of loss or damage to Contract Activities remains with Contractor. Contractor is responsible for filing, processing, and collecting all damage claims. The State will record and report to Contractor any evidence of visible damage. If the State rejects the Contract Activities, Contractor must remove them from the premises within 10 calendar days after notification of rejection. The risk of loss of rejected or non-conforming Contract Activities remains with Contractor. Rejected Contract Activities not removed by Contractor within 10 calendar days will be deemed abandoned by Contractor, and the State will have the right to dispose of it as its own property. Contractor must reimburse the State for costs and expenses incurred in storing or effecting removal or disposition of rejected Contract Activities.

19. **Warranty Period**. The warranty period, if applicable, for Contract Activities is a fixed period commencing on the date specified in Exhibit A. If the Contract Activities do not function as warranted during the warranty period the State may return such non-conforming Contract Activities to the Contractor for a full refund.

20. **Terms of Payment.** Invoices must conform to the requirements communicated from time-to-time by the State. All undisputed amounts are payable within 45 days of the State's receipt. Contractor may only charge for Contract Activities performed as specified in Exhibit A. Invoices must include an itemized statement of all charges. The State is exempt from State sales tax for direct purchases and may be exempt from federal excise tax, if Services purchased under this Agreement are for the State's exclusive use. Notwithstanding the foregoing, all prices are inclusive of taxes, and Contractor is responsible for all sales, use and excise taxes, and any other similar taxes, duties and charges of any kind imposed by any federal, state, or local governmental entity on any amounts payable by the State under this Contract.

The State has the right to withhold payment of any disputed amounts until the parties agree as to the validity of the disputed amount. The State will notify Contractor of any dispute within a reasonable time. Payment by the State will not constitute a waiver of any rights as to Contractor's continuing obligations, including claims for deficiencies or substandard Contract Activities. Contractor's acceptance of final payment by the State constitutes a waiver of all claims by Contractor against the State for payment under this Contract, other than those claims previously filed in writing on a timely basis and still disputed.

The State will only disburse payments under this Contract through Electronic Funds Transfer (EFT). Contractor must register with the State at http://www.michigan.gov/cpexpress to receive electronic fund transfer payments. If Contractor does not register, the State is not liable for failure to provide payment.
Without prejudice to any other right or remedy it may have, the State reserves the right to set off at any time any amount then due and owing to it by Contractor against any amount payable by the State to Contractor under this Contract.

21. **Liquidated Damages.** Liquidated damages, if applicable, will be assessed as described in Exhibit A-1 and Exhibit A-2.

22. **Stop Work Order.** The State may suspend any or all activities under the Contract at any time. The State will provide Contractor a written stop work order detailing the suspension. Contractor must comply with the stop work order upon receipt. Within 90 calendar days, or any longer period agreed to by Contractor, the State will either: (a) issue a notice authorizing Contractor to resume work, or (b) terminate the Contract or purchase order. The State will not pay for Contract Activities, Contractor's lost profits, or any additional compensation during a stop work period.

23. **Termination for Cause.** The State may terminate this Contract for cause, in whole or in part, if Contractor, as determined by the State: (a) endangers the value, integrity, or security of any location, data, or personnel; (b) becomes insolvent, petitions for bankruptcy court proceedings, or has an involuntary bankruptcy proceeding filed against it by any creditor; (c) engages in any conduct that may expose the State to liability; (d) breaches any of its material duties or obligations; or (e) fails to cure a breach within the time stated in a notice of breach. Any reference to specific breaches being material breaches within this Contract will not be construed to mean that other breaches are not material.

    If the State terminates this Contract under this Section, the State will issue a termination notice specifying whether Contractor must: (a) cease performance immediately, or (b) continue to perform for a specified period. If it is later determined that Contractor was not in breach of the Contract, the termination will be deemed to have been a Termination for Convenience, effective as of the same date, and the rights and obligations of the parties will be limited to those provided in Section 24, Termination for Convenience.

    The State will only pay for amounts due to Contractor for Contract Activities accepted by the State on or before the date of termination, subject to the State's right to set off any amounts owed by the Contractor for the State's reasonable costs in terminating this Contract. In the event the State terminates this Contract for cause, the Contractor must pay all reasonable costs incurred by the State in terminating this Contract for cause as permitted by Michigan law.

24. **Termination for Convenience.** The State may immediately terminate this Contract in whole or in part without penalty and for any reason, including but not limited to, appropriation or budget shortfalls. The termination notice will specify whether Contractor must: (a) cease performance of the Contract Activities immediately, or (b) continue to perform the Contract Activities in accordance with Section 25, Transition Responsibilities. If the State terminates this Contract for convenience, the State will pay all reasonable costs, as determined by the State, for State approved Transition Responsibilities.

25. **Transition Responsibilities.** Upon termination or expiration of this Contract for any reason, Contractor must, for a period of time specified by the State (not to exceed 90 calendar days), provide all reasonable transition assistance requested by the State, to allow for the expired or terminated portion of the Contract Activities to continue without interruption or adverse effect, and to facilitate the orderly transfer of such Contract Activities to the State or its designees. Such transition assistance may include, but is not limited to: (a) continuing to perform the Contract Activities at the established Contract rates; (b) taking all reasonable and necessary measures to transition performance of the work, including all applicable Contract Activities, training, equipment, software, leases, reports and other documentation, to the State or the State's designee; (c) taking all necessary and appropriate steps, or such other action as the State may direct, to preserve, maintain, protect, or return to the State all materials, data, property, and confidential information provided directly or indirectly to Contractor by any entity, agent, vendor, or employee of the State; (d) transferring title in and delivering to the State, at the State's discretion, all completed or partially completed deliverables prepared under this Contract as of the Contract termination date; and (e) preparing an accurate accounting from which the State and Contractor may reconcile all outstanding accounts (collectively, "**Transition Responsibilities**"). This Contract will automatically be extended through the end of the transition period.

26. **General Indemnification.** Contractor must defend, indemnify and hold the State, its departments, divisions, agencies, offices, commissions, officers, and employees harmless, without limitation, from and against any and all losses, liabilities, damages, reasonable costs, reasonable attorney fees, and expenses (including those required to establish the right to indemnification), to the extent such losses, liabilities, damages, reasonable costs, reasonable attorney fees, and expenses arise out of third-party claims or actions of or relating to: (a) any infringement, misappropriation, or other violation of any intellectual property right or other right of any third party; (b) any bodily injury, death, or damage to real or tangible personal property occurring wholly due to negligent action or inaction by Contractor (or any of Contractor's employees, agents, subcontractors, or by anyone else for whose acts any of them may be liable) that arise from the Contractor's performance of this Contract.

    The State will notify Contractor in writing if indemnification is sought within a reasonable time; however, failure to do so will not relieve Contractor, except to the extent that Contractor is materially prejudiced. Contractor must, to the satisfaction of the State, demonstrate its financial ability to carry out these obligations.

    The State is entitled to: (i) regular updates on proceeding status; (ii) participate in the defense of the proceeding; (iii) employ its own counsel; and to (iv) retain control of the defense if the State deems necessary. Contractor will not, without the State's written consent (not to be unreasonably withheld), settle, compromise, or consent to the entry of any judgment in or otherwise seek to terminate any claim, action, or proceeding. To the extent that any State employee, official, or law may be involved or challenged, the State may, at its own expense, control the defense of that portion of the claim.

Any litigation activity on behalf of the State, or any of its subdivisions under this Section, must be coordinated with the Department of Attorney General. An attorney designated to represent the State may not do so until approved by the Michigan Attorney General and appointed as a Special Assistant Attorney General.

27. **Infringement Remedies.** If, in either party's opinion, any piece of equipment, software, commodity, or service supplied by Contractor or its subcontractors, or its operation, use or reproduction, is likely to become the subject of a copyright, patent, trademark, or trade secret infringement claim, Contractor must, at its expense: (a) procure for the State the right to continue using the equipment, software, commodity, or service, or if this option is not reasonably available to Contractor, (b) replace or modify the same so that it becomes non-infringing; or (c) accept its return by the State with appropriate credits to the State against Contractor's charges and reimburse the State for any losses or costs incurred as a consequence of the State ceasing its use and returning it.

28. **Limitation of Liability.** Neither party is liable for consequential, incidental, indirect, or special damages, regardless of the nature of the action. Contractor's liability for contract damages is limited to no more than $500,000, or twice the total anticipated Contract value based on the initial two-year term of the Contract, whichever is higher.

29. **Disclosure of Litigation, or Other Proceeding.** Contractor must notify the State within 14 calendar days of receiving notice of any litigation, investigation, arbitration, or other proceeding (collectively, "**Proceeding**") involving Contractor, a subcontractor, or an officer or director of Contractor or subcontractor, that arises during the term of the Contract, including: (a) a criminal Proceeding; (b) a parole or probation Proceeding; (c) a Proceeding under the Sarbanes-Oxley Act; (d) a civil Proceeding involving: (1) a claim that might reasonably be expected to adversely affect Contractor's viability or financial stability; or (2) a governmental or public entity's claim or written allegation of fraud; or (e) a Proceeding involving any license that Contractor is required to possess in order to perform under this Contract.

30. **State Data.**
    a. Ownership. The State's data ("**State Data**," which will be treated by Contractor as Confidential Information) includes: (a) the State's data collected, used, processed, stored, or generated as the result of the Contract Activities; (b) personally identifiable information ("**PII**") collected, used, processed, stored, or generated as the result of the Contract Activities, including, without limitation, any information that identifies an individual, such as an individual's social security number or other government-issued identification number, date of birth, address, telephone number, biometric data, mother's maiden name, email address, credit card information, or an individual's name in combination with any other of the elements here listed; and, (c) personal health information ("**PHI**") collected, used, processed, stored, or generated as the result of the Contract Activities, which is defined under the Health Insurance Portability and Accountability Act (HIPAA) and its related rules and regulations. State Data is and will remain the sole and exclusive property of the State and all right, title, and interest in the same is reserved by the State. This Section survives the termination of this Contract.

    b. Contractor Use of State Data. Contractor is provided a limited license to State Data for the sole and exclusive purpose of providing the Contract Activities, if any that involve the use of State Data, including a license to collect, process, store, generate, and display State Data only to the extent necessary in the provision of the Contract Activities. Contractor must: (a) keep and maintain State Data in strict confidence, using such degree of care as is appropriate and consistent with its obligations as further described in this Contract and applicable law to avoid unauthorized access, use, disclosure, or loss; (b) use and disclose State Data solely and exclusively for the purpose of providing the Contract Activities, such use and disclosure being in accordance with this Contract, any applicable Statement of Work, and applicable law; and (c) not use, sell, rent, transfer, distribute, or otherwise disclose or make available State Data for Contractor's own purposes or for the benefit of anyone other than the State without the State's prior written consent. This Section survives the termination of this Contract.

    c. Extraction of State Data. Contractor must, within five (5) business days of the State's request, provide the State, without charge and without any conditions or contingencies whatsoever (including but not limited to the payment of any fees due to Contractor), an extract of the State Data in the format specified by the State.

    d. Backup and Recovery of State Data. Unless otherwise specified in Exhibit A, Contractor is responsible for maintaining a backup of State Data and for an orderly and timely recovery of such data. Unless otherwise described in Exhibit A, Contractor must maintain a contemporaneous backup of State Data that can be recovered within two (2) hours at any point in time.

    e. Loss of Data. In the event of any act, error or omission, negligence, misconduct, or breach that compromises or is suspected to compromise the security, confidentiality, or integrity of State Data or the physical, technical, administrative, or organizational safeguards put in place by Contractor that relate to the protection of the security, confidentiality, or integrity of State Data, Contractor must, as applicable: (a) notify the State as soon as practicable but no later than twenty-four (24) hours of becoming aware of such occurrence; (b) cooperate with the State in investigating the occurrence, including making available all relevant records, logs, files, data reporting, and other materials required to comply with applicable law or as otherwise required by the State; (c) in the case of PII or PHI, at the State's sole election, (i) notify the affected individuals who comprise the PII or PHI as soon as practicable but no later than is required to comply with applicable law, or, in the absence of any legally required notification period, within 5 calendar days of the occurrence; or (ii) reimburse the State for any costs in notifying the affected individuals; (d) in the case of PII, provide third-party credit and identity monitoring services to each of the affected individuals who comprise the PII for the period required to comply with applicable law, or, in the absence of any legally required monitoring services, for no less than twenty-four (24) months

following the date of notification to such individuals; (e) perform or take any other actions required to comply with applicable law as a result of the occurrence; (f) without limiting Contractor's obligations of indemnification as further described in this Contract, indemnify, defend, and hold harmless the State for any and all claims, including reasonable attorneys' fees, costs, and expenses incidental thereto, which may be suffered by, accrued against, charged to, or recoverable from the State in connection with the occurrence; (g) be responsible for recreating lost State Data in the manner and on the schedule set by the State without charge to the State; and, (h) provide to the State a detailed plan within 10 calendar days of the occurrence describing the measures Contractor will undertake to prevent a future occurrence. Notification to affected individuals, as described above, must comply with applicable law, be written in plain language, and contain, at a minimum: name and contact information of Contractor's representative; a description of the nature of the loss; a list of the types of data involved; the known or approximate date of the loss; how such loss may affect the affected individual; what steps Contractor has taken to protect the affected individual; what steps the affected individual can take to protect himself or herself; contact information for major credit card reporting agencies; and, information regarding the credit and identity monitoring services to be provided by Contractor. This Section survives the termination of this Contract.

31. **Non-Disclosure of Confidential Information**. The parties acknowledge that each party may be exposed to or acquire communication or data of the other party that is confidential, privileged communication not intended to be disclosed to third parties. The provisions of this Section survive the termination of this Contract.

a. Meaning of Confidential Information. For the purposes of this Contract, the term "**Confidential Information**" means all information and documentation of a party that: (a) has been marked "confidential" or with words of similar meaning, at the time of disclosure by such party; (b) if disclosed orally or not marked "confidential" or with words of similar meaning, was subsequently summarized in writing by the disclosing party and marked "confidential" or with words of similar meaning; and, (c) should reasonably be recognized as confidential information of the disclosing party. The term "Confidential Information" does not include any information or documentation that was: (a) subject to disclosure under the Michigan Freedom of Information Act (FOIA); (b) already in the possession of the receiving party without an obligation of confidentiality; (c) developed independently by the receiving party, as demonstrated by the receiving party, without violating the disclosing party's proprietary rights; (d) obtained from a source other than the disclosing party without an obligation of confidentiality; or, (e) publicly available when received, or thereafter became publicly available (other than through any unauthorized disclosure by, through, or on behalf of, the receiving party). For purposes of this Contract, in all cases and for all matters, State Data is deemed to be Confidential Information.

b. Obligation of Confidentiality. The parties agree to hold all Confidential Information in strict confidence and not to copy, reproduce, sell, transfer, or otherwise dispose of, give or disclose such Confidential Information to third parties other than employees, agents, or subcontractors of a party who have a need to know in connection with this Contract or to use such Confidential Information for any purposes whatsoever other than the performance of this Contract. The parties agree to advise and require their respective employees, agents, and subcontractors of their obligations to keep all Confidential Information confidential. Disclosure to a subcontractor is permissible where: (a) use of a subcontractor is authorized under this Contract; (b) the disclosure is necessary or otherwise naturally occurs in connection with work that is within the subcontractor's responsibilities; and (c) Contractor obligates the subcontractor in a written contract to maintain the State's Confidential Information in confidence. At the State's request, any employee of Contractor or any subcontractor may be required to execute a separate agreement to be bound by the provisions of this Section.

c. Cooperation to Prevent Disclosure of Confidential Information. Each party must use its best efforts to assist the other party in identifying and preventing any unauthorized use or disclosure of any Confidential Information. Without limiting the foregoing, each party must advise the other party immediately in the event either party learns or has reason to believe that any person who has had access to Confidential Information has violated or intends to violate the terms of this Contract and each party will cooperate with the other party in seeking injunctive or other equitable relief against any such person.

d. Remedies for Breach of Obligation of Confidentiality. Each party acknowledges that breach of its obligation of confidentiality may give rise to irreparable injury to the other party, which damage may be inadequately compensable in the form of monetary damages. Accordingly, a party may seek and obtain injunctive relief against the breach or threatened breach of the foregoing undertakings, in addition to any other legal remedies which may be available, to include, in the case of the State, at the sole election of the State, the immediate termination, without liability to the State, of this Contract or any Statement of Work corresponding to the breach or threatened breach.

e. Surrender of Confidential Information upon Termination. Upon termination of this Contract or a Statement of Work, in whole or in part, each party must, within 5 calendar days from the date of termination, return to the other party any and all Confidential Information received from the other party, or created or received by a party on behalf of the other party, which are in such party's possession, custody, or control; provided, however, that Contractor must return State Data to the State following the timeframe and procedure described further in this Contract. Should Contractor or the State determine that the return of any Confidential Information is not feasible, such party must destroy the Confidential Information and must certify the same in writing within 5 calendar days from the date of termination to the other party.

32. **Reserved.**
33. **Reserved.**
34. **Reserved.**

35. **Records Maintenance, Inspection, Examination, and Audit.** The State or its designee may audit Contractor to verify compliance with this Contract. Contractor must retain, and provide to the State or its designee and the auditor general upon request, all financial and accounting records related to the Contract through the term of the Contract and for 4 years after the latter of termination, expiration, or final payment under this Contract or any extension ("**Audit Period**"). If an audit, litigation, or other action involving the records is initiated before the end of the Audit Period, Contractor must retain the records until all issues are resolved.

    Within 10 calendar days of providing notice, the State and its authorized representatives or designees have the right to enter and inspect Contractor's premises or any other places where Contract Activities are being performed, and examine, copy, and audit all records related to this Contract. Contractor must cooperate and provide reasonable assistance. If any financial errors are revealed, the amount in error must be reflected as a credit or debit on subsequent invoices until the amount is paid or refunded. Any remaining balance at the end of the Contract must be paid or refunded within 45 calendar days.

    This Section applies to Contractor, any parent, affiliate, or subsidiary organization of Contractor, and any subcontractor that performs Contract Activities in connection with this Contract.

36. **Warranties and Representations.** Contractor represents and warrants: (a) Contractor is the owner or licensee of any Contract Activities that it licenses, sells, or develops and Contractor has the rights necessary to convey title, ownership rights, or licensed use; (b) all Contract Activities are delivered free from any security interest, lien, or encumbrance and will continue in that respect; (c) the Contract Activities will not infringe the patent, trademark, copyright, trade secret, or other proprietary rights of any third party; (d) Contractor must assign or otherwise transfer to the State or its designee any manufacturer's warranty for the Contract Activities; (e) the Contract signatory has the authority to enter into this Contract; (f) all information furnished by Contractor in connection with the Contract fairly and accurately represents Contractor's business, properties, finances, and operations as of the dates covered by the information, and Contractor will inform the State of any material adverse changes; and (g) all information furnished and representations made in connection with the award of this Contract is true, accurate, and complete, and contains no false statements or omits any fact that would make the information misleading. A breach of this Section is considered a material breach of this Contract, which entitles the State to terminate this Contract under Section 23, Termination for Cause.

37. **Conflicts and Ethics.** Contractor will uphold high ethical standards and is prohibited from: (a) holding or acquiring an interest that would conflict with this Contract; (b) doing anything that creates an appearance of impropriety with respect to the award or performance of the Contract; (c) attempting to influence or appearing to influence any State employee by the direct or indirect offer of anything of value; or (d) paying or agreeing to pay any person, other than employees and consultants working for Contractor, any consideration contingent upon the award of the Contract. Contractor must notify the State of any violation or potential violation of these standards within 90 calendar days of becoming aware of such violation or potential violation. This Section applies to Contractor, any parent, affiliate, or subsidiary organization of Contractor, and any subcontractor that performs Contract Activities in connection with this Contract.

38. **Compliance with Laws.** Contractor must comply with all federal, state and local laws, rules and regulations.

39. **Reserved.**
40. **Reserved.**

41. **Nondiscrimination.** Under the Elliott-Larsen Civil Rights Act, 1976 PA 453, MCL 37.2101, *et seq*., and the Persons with Disabilities Civil Rights Act, 1976 PA 220, MCL 37.1101, *et seq*., Contractor and its subcontractors agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height, weight, marital status, or mental or physical disability. Breach of this covenant is a material breach of this Contract.

42. **Unfair Labor Practice.** Under MCL 423.324, the State may void any Contract with a Contractor or subcontractor who appears on the Unfair Labor Practice register compiled under MCL 423.322.

43. **Governing Law.** This Contract is governed, construed, and enforced in accordance with Michigan law, excluding choice-of-law principles, and all claims relating to or arising out of this Contract are governed by Michigan law, excluding choice-of-law principles. Any dispute arising from this Contract must be resolved in Michigan Court of Claims. Contractor consents to venue in Ingham County, and waives any objections, such as lack of personal jurisdiction or *forum non conveniens*. Contractor must appoint agents in Michigan to receive service of process.

44. **Non-Exclusivity.** Nothing contained in this Contract is intended nor will be construed as creating any requirements contract with Contractor. This Contract does not restrict the State or its agencies from acquiring similar, equal, or like Contract Activities from other sources.
45. **Force Majeure.** Neither party will be in breach of this Contract because of any failure arising from any disaster or acts of god that are beyond their control and without their fault or negligence. Each party will use commercially reasonable efforts to resume performance. Contractor will not be relieved of a breach or delay caused by its subcontractors. If immediate performance is necessary to ensure public health and safety, the State may immediately contract with a third party.

46. **Dispute Resolution.** The parties will endeavor to resolve any Contract dispute in accordance with this provision. The dispute will be referred to the parties' respective Contract Administrators or Program Managers. Such referral must include a description of the issues and all supporting documentation. The parties must submit the dispute to a senior executive if unable to resolve the dispute within 15 business days. The parties will continue performing while a dispute is being resolved, unless the dispute precludes performance. A dispute involving payment does not preclude performance.

    Litigation to resolve the dispute will not be instituted until after the dispute has been elevated to the parties' senior executive and either concludes that resolution is unlikely, or fails to respond within 15 business days. The parties are not prohibited from instituting formal proceedings: (a) to avoid the expiration of statute of limitations period; (b) to preserve a superior position with respect to creditors; or (c) where a party makes a determination that a temporary restraining order or other injunctive relief is the only adequate remedy. This Section does not limit the State's right to terminate the Contract.

47. **Media Releases.** News releases (including promotional literature and commercial advertisements) pertaining to the Contract or project to which it relates must not be made without prior written State approval, and then only in accordance with the explicit written instructions of the State.

48. **Website Incorporation.** The State is not bound by any content on Contractor's website unless expressly incorporated directly into this Contract.

49. **Order of Precedence.** In the event of a conflict between the terms and conditions of the Contract, the exhibits, a purchase order, or an amendment, the order of precedence is: (a) the purchase order; (b) the amendment; (c) Exhibit A; (d) any other exhibits; and (e) the Contract.

50. **Severability.** If any part of this Contract is held invalid or unenforceable, by any court of competent jurisdiction, that part will be deemed deleted from this Contract and the severed part will be replaced by agreed upon language that achieves the same or similar objectives. The remaining Contract will continue in full force and effect.

51. **Waiver.** Failure to enforce any provision of this Contract will not constitute a waiver.

52. **Survival.** The provisions of this Contract that impose continuing obligations, including warranties and representations, termination, transition, insurance coverage, indemnification, and confidentiality, will survive the expiration or termination of this Contract.

53. **Entire Contract and Modification.** This Contract is the entire agreement and replaces all previous agreements between the parties for the Contract Activities. This Contract may not be amended except by signed agreement between the parties (a "**Contract Change Notice**").

STATE OF MICHIGAN

Contract No. 071B6600018
License Plate Sheeting, Road Sign Sheeting, and Pavement Markers

Background
This is a statewide contract for reflective sheeting to be used primarily in the production of license plates, road signs, and pavement markers for the Department of Corrections and their License Plate Factory, the Department of Transportation, and the Department of Natural Resources. Other State agencies may utilize this contract.

EXHIBIT A-1
License Plate Reflective Sheeting
STATEMENT OF WORK
CONTRACT ACTIVITIES

This exhibit identifies the requirements for the License Plate Reflective Sheeting portion of this Contract.

1. General Requirements
1.1 Transition Out

Upon Cancellation or Expiration (transition out):

- **a)** The State will follow the guidelines as outlined in Section 25 – Transition Responsibilities under the Standard Terms and Conditions.
- **b)** All equipment supplied by Contractor will be available to the State until completion of successful transition in of new vendor.
- **c)** The outgoing vendor will be responsible for the removal of all contractor owned equipment and cleanup of any materials, hazardous or otherwise.

1.2 Product Requirements

- **a)** The end product produced through Contractor's equipment will be a retro-reflective license plate consisting of retro-reflective (hereinafter referred to as "reflective" only) sheeting laminated to a specified aluminum substrate which is then embossed and message roll coated according to the sheeting manufacturer's recommendations.
- **b)** The reflective sheeting shall consist of lens elements enclosed within a transparent resin and shall have a pre-coated pressure sensitive adhesive backing protected by a removable liner. The pre-printed design, in the reflective sheeting, shall be buried below the sheeting surface to ensure reliable long-term durability.
- **c)** The reflective sheeting, when applied to the license plate substrate and blanked to finished size, shall contain identifying marks for purposes of on-vehicle traceability and warranty enforcement in accordance with these specifications. The warranty marks shall be buried below the sheeting surface for durability and shall incorporate the manufacturer's production run number that designates the source of manufacture, year of manufacture, and specific lot from which the material was supplied. The warranty marks shall not interfere or detract from the graphic design or reduce sheeting brightness.
- **d)** Pre-printed reflective sheeting shall conform to the design, colors and sheeting type as approved by the State and reflective sheeting manufacturer.
- **e)** Conform to all performance requirements of this specification as specified in **Section 1.7** and as tested by the State designated testing lab;
- **f)** The sheeting manufacturer shall provide a directional warranty mark in the sheeting in accordance with **section 1.3.**
- **g)** Contractor certifies that they can provide special graphic designs in quantities of one 750 ft. roll upon request by the license plate manufacturing facility supervisor.
- **h)** The sheeting manufacturer shall provide technical data exhibiting characteristics of all materials. Information provided shall include detailed processing conditions for each phase of license plate manufacturer. Such information shall also include times and temperatures required for curing of any inks and clear-coats (if required) for use in the production of completed license plates. (See ***"Attachment B - 3M Product Bulletins for Reflective Sheeting and Pavement Marking Tape***" 4770 Series ET for technical data exhibiting characteristics of the materials a diagram showing the phases of license plate manufacture).

1.3 Warranties

a) For warranty purposes, the sheeting shall be marked so as to be traceable to the specific manufacturer's production run numbers from which the material originated. If at any time during the specified performance life of the reflective material provided, a one-half of one per cent sample of clean, rear plates produced from a given production run (identified by the integral warranty mark) reveals that 10% or more of that sample are found to be defective in visual or brightness performance requirements as defined herein, the Contractor shall be responsible for replacement of all plates manufactured from that specific lot of material.

b) The sheeting manufacturer shall be responsible for all replacement costs associated with a specific lot. Contractor's liability under this warranty is limited to replacement as stated herein, and Contractor assumes no liability for any incidental or consequential damages, such as profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. This warranty is made in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability, fitness for a particular purpose, and any implied warranty arising out of a course of dealing or of performance, custom or usage of trade.

c) To assure effective identification, the warranty marks shall be approximately 1.125 inches in diameter on standard 6" x 12" plates and shall be of a design mutually agreed upon by the State and the sheeting manufacturer. The manufacturer may vary the number, design and placement of the marks for motorcycle or smaller license plate sizes.

d) The warranty marks shall be verifiable on a license plate once properly affixed to the vehicle's designated mounting area, from an approximate head-on distance of six (6) feet; warranty marks shall not be observable at two (2) feet or twenty (20) feet or when the viewer steps to one side from the head-on viewing position so as not to compete or conflict with the plate design or aesthetics, and shall not alter sheeting colors or reduce sheeting brightness below specified levels.

e) Contractor will also include an additional security feature, VST, with the license plate sheeting. Series 4770T sheeting with 3M™ Ensure™ Virtual Security Thread (VST) contains a second mark that runs vertically or horizontally through standard vehicle registration plates for purposes of security and anti-counterfeiting. The VST is buried beneath the surface of the sheeting and consists of two sinusoidal waves where one wave appears to float above and one wave appears to float below the Ensure image in the retroreflective sheeting. The VST is durable for the service life of the license plate.

f) The VST is visible in the unprinted areas of the plate from within a standard police vehicle under high beam headlight illumination, as well as outside of the vehicle, on a license plate properly affixed to the vehicle's designated mounting area, from an approximate distance of 0 to 50 feet (0 to 15 meters) at a head-on viewing angle. The two sinusoidal wave images are visibly distinct from an approximate distance of 0 to 20 feet (0 to 6 meters). The VST is not visible when viewed from an angle greater than 45 degrees from the head-on viewing position.

1.4 Recall Requirements and Procedures

a) Contractor has in place a corporate global ***"Nonconforming Product Recovery and Withdrawal (Including Recall) Policy"*** along with the supporting procedures in the event a product recall is required. The policy applies to all Contractor employees globally involved in the evaluation, withdrawal and recovery of potentially nonconforming or known nonconforming product and defines the minimum requirements for withdrawal or recovery actions. Nonconforming product by Contractor's definition is a product that is identified as not conforming to (a) performance requirements, (b) regulatory, safety or other requirements such as labeled claims or (c) standards adopted by Contractor. This policy applies to all products, including private label and outsourced products.

b) When a potential issue is identified, the assigned Quality Manager (QM) will be notified. The QM will research the issue with relevant internal experts and (if necessary) oversee the development of an action plan, as well as a communication plan to inform affected customers (i.e. Contract Administrator, Program Manager, and License Plate Factory Supervisor). Response to this issue will be made via email and/or phone communication within a reasonable period of time.

1.5 Quality Assurance Program

a) Both Contractor's business and manufacturing site for license plate reflective sheeting are certified to the ISO 9001:2008 standard by a third party agency. As part of this standard's certification, Contractor's quality management systems have been deemed to be both comprehensive and effective in supporting their products, including license plate reflective sheeting.

b) The State reserves the right to periodically test products which have been received to verify compliance with specifications. If laboratory analysis shows that the product does not meet specifications or fails to perform satisfactorily at any time, the sheeting manufacturer shall be responsible for:

I. All costs of testing and laboratory analysis.

II. Disposal and/or replacement of all products which fail to meet specifications.
III. All costs or repair and/or replacement of equipment deemed to have been damaged by substandard products, as determined by the State.
IV. Reimbursement of all costs associated with loss/waste of steel, aluminum, or other blank material which shall be caused by the substandard products supplied by the sheeting manufacturer, as determined by the State.

1.6 Incentives

a) Contractor will offer a 2% 20 Net 30 terms discount as an incentive to the State of Michigan.
b) Because Contractor was awarded all three categories (License Plate Sheeting, Road Sign Reflective Sheeting, and Pavement Marking Tape), an additional 1% price discount will be applied and is reflected in ***"Attachment A - Price Sheet"***.

1.7 Performance Standards

1.7.1 License Plate Sheeting

a) Substrate: The proposed sheeting will be able to be laminated to a properly treated aluminum substrate as recommended by the sheeting manufacturer.
b) Diffuse Daytime Color: Through instrumental color testing, the diffuse daytime color of the reflective sheeting shall conform to color requirements as determined spectrophotometrically in accordance with ASTM E-1164 and E-1349, utilizing either .45/0 or 0/45 degree illumination/viewing conditions as described in E-1164 and E-1349 for retro-reflective materials. Chromaticity and the Luminance Factor based on CIE tristimulus values for the 2º observer and Illuminant D65, shall be calculated in accordance with ASTM E-308.
c) Color Specification:

Color	Chromaticity Coordinate Corner Points		Luminance Factor
	X	Y	Y(%)
White	0.303	0.287	42. Min.
	0.368	0.353	
	0.340	0.380	
	0.274	0.316	

d) Adhesive and Protective Liner: Test plates as prepared by manufacturers recommendations will resist peeling, scuffing and marring from recommended application surfaces, during normal use handling, and resists shocking off when jabbed with a spatula at -10°F (-23°C).

Prior to application, the protective paper liner can be removed from the adhesive by peeling without soaking in water or other solvents. The liner can be removed after accelerated storage for 4 hours at 150°F (65°C) under a weight of 2.5 pounds per square inch (0.18 kg/cm²)
e) Flexibility – Embossing: The sheeting shall, when correctly applied to treated aluminum, conform to the minimum/maximum tolerances for embossing and/or deposing dies as used by the manufacturing facility that supplies finished plates to the State and as recommended by the sheeting manufacturer.
f) Roll Coating: The reflective sheeting shall be roll coated and compatible with transparent and opaque colors as provided by the sheeting manufacturer.
g) Inventory Control: To assist the license plate factory with inventory control problems, the sheeting manufacturer shall mark the sheeting so that the license plate factory can employ first in/first out principles.

1.7.2 Finished License Plates

a) Test panels shall be prepared in accordance with **Section 1.8 Paragraph a**.
b) Retro-reflective Characteristics: The co-efficient or retro-reflection for the sheeting shall be measured on flat, clean, finished license plate test panels and shall have the following minimum values at 0.2º observation angle, expressed as candlepower per foot-candle per square foot (candelas per lux per square meter) of material. Measurements shall be conducted in accordance with ASTM E-810, "Standard Test Method for Co-efficient of Retro-reflection of Retro-reflective Sheeting".

Color	Entrance -4°	Angle°	Color	Entrance -4°	Angle 40°
White	50	16	Gold	25	10
Yellow	25	10	Green	18	7
Orange	25	10	Blue	18	7
Lemon-Yellow	25	10	Red	9	3

c) **Rainfall Performance:** The Co-efficient of Retro-reflection of the same finished license plate test panels, measured on the same flat area of the test panels, totally wet by rain, shall not be less than 90% of the values specified above. Wet performance measurements shall be conducted at 0.2º observation and -4º entrance angles in accordance with ASTM E-810 and using the test set-up described in section 7.10.1 of AASHTO M 268.

d) **Daytime/Nighttime Color:** To assist in positive daytime/nighttime identification of license plates, the color of the reflective background of the sheeting, including any pre-printed design, shall be similar in daylight and by illumination at night.

e) **Cleanability:** Finished license plates, manufactured in accordance with the recommendations of the reflective sheeting manufacturer, shall be easily cleansed of normal dirt accumulation by washing with water and mild detergent. A test panel shall be sprayed with water-suspended soils collected from the underside of vehicle fenders, mixed with water in the proportion of five pounds (2.27 kg) of soil to one gallon (3.78 liters) of water, and poured through a paint strainer. The mixture shall then be sprayed onto the panel while particles are in suspension. After the panel is thoroughly dry, it shall be cleaned by washing with a mixture of water and mild detergent, rinsed with clean water and wiped dry for examination. The panel shall show no appreciable difference when compared to a new clean panel.

f) **Solvent Resistance:** License plates finished according to the manufacturer's recommendations shall be sufficiently solvent resistant to permit cleaning with VM&P naphtha, mineral spirits, turpentine or other solvents commonly used on vehicle finishes. Rinsed and dried, the plate surface shall show no appreciable change following cleaning.

g) **Temporary Water Repellent Surface Coating:** To check for temporary water repellent surface coatings, a test panel shall be exposed for 105 hours to Twin Arc Weathering per ASTM G23-81 type E. Following exposure the panel shall be washed in a 5% HCL solution for 45 seconds, rinsed thoroughly with water, dried with a soft clean cloth, and brought to equilibrium at 72ºF plus or minus 5ºF and 50% plus or minus 5% R.H. The panel shall then be measured for coefficient of retro-reflection and shall maintain not less than 90% of the specified dry and wet minimum values in II.B.3 and 4. The panel shall show no appreciable discoloration, cracking, crazing, blistering, lifting or dimensional change. The surface shall continue to be essentially smooth and provide a compatible surface for direct application of validation stickers with pressure sensitive adhesive.

1.8 Test Panels and Quality Conformance

a) **Test Panels:** Finished license plate test panels 6" x 12" (15.2cm x 30.5cm) must be provided for testing and evaluation within seven (7) calendar days of request as required by the State, and shall be produced of the same materials, on the same equipment and by the same general processes of substrate preparation, laminating, embossing or debossing, roll coating and clear coating (if required) as the production plates, in accordance with the sheeting manufacturer recommendations. Note the following test panel exception for photometric testing.

   Special test panels for photometric testing shall be produced as above, except that they shall not be embossed (or debossed) and they shall not be roll coated. The test panels shall be clear coated (if required) as specified.

   All test panels must be conditioned for at least 24 hours at 72º $\pm$ 5ºF (22º $\pm$ 1ºC) and 50% $\pm$ 2% R.H. prior to testing.

   This testing will be ongoing throughout the duration of this contract as requested by the State.

b) **Quality Conformance:** Failure of the reflective sheeting to meet any requirement specified herein shall be cause for refusal to accept materials until evidence has been provided by the manufacturer that corrective action has been taken to eliminate deficiencies.

1.9 Performance Life:

Reflective sheeting applied and processed into finished license plates according to the sheeting manufacturer's instructions shall be considered to perform effectively for the service life specified (excluding those plates showing mechanical damage) if:

a) The plates show no fading, cracking, blistering or peeling which will significantly impair the intended visibility or legibility of the plates, and if

b) The clean rear plate retains at least 5 candlepower per foot candle per plate (0.46 candelas per lux per plate) for the length of the intended issued being bid.

c) Measurements shall be conducted at 0.2º observation angle and -4º entrance angle. Coefficient of Luminous Intensity shall be measured using the test method outlined in ASTM E-810 except that the Coefficient of Luminous Intensity shall be determined in accordance with ASTM E-808 Para. 4.2.1 and ASTM E-809 Para. 12.1.1.

2. Service Levels

2.1 Delivery Time Frames

a) Contractor's standard lead time is to ship 30-45 days After Receipt of Order (ARO).
b) Inks and thinners will be shipped within 14 days ARO.
c) In the event of equipment failure, Contractor will ship stocked replacement parts by express carrier within 12 hours of notification.

2.2 Delivery Method

a) All deliveries shall be provided F.O.B. to the State's designated point of delivery.

2.3 Installation

a) If new equipment is requested or proposed from either party during the term of this contract, the Contractor shall provide all necessary equipment for the intended Contract period to manufacture reflective license plates. The Contractor will also align and/or move all new and/or existing State owned equipment to ensure correct manufacturing processing. The Contractor will also install all provided equipment.
b) If new equipment is requested or proposed from either party during the term of this contract, State and local permits, if required for equipment operation or installation, must be obtained by the Contractor.
c) If new equipment is requested or proposed from either party during the term of this contract, all items required for any manufacturing process are considered equipment, with the single exception of "clapper dies" and sheeting. The first blanking line shall be installed no later than 45 calendar days after installation of equipment. The second blanking line shall be installed no later than 30 days after the first installation.
d) If new equipment is requested or proposed from either party during the term of this contract, operation of manufacturing system, installation of equipment, and storage of supplies and chemicals, as well as waste discharge, must comply with all federal, state and local (Adrian, MI) standards and requirements.
e) The Contractor will supply a letter verifying that all MIOSHA requirements and all State of Michigan air/water standards will be met. These requirements shall be met throughout the term of this contract. (Please refer to the attached Material Specification Certificate of Compliance).
f) If new equipment is requested or proposed from either party during the term of this contract, the cost of any waste materials, including metal and sheeting generated because of installation and testing of application, stretch, and registry equipment will be reimbursed to the State by the successful Contractor provided that it is pre-approved, in writing, by the Program Manager. Any salary costs generated because the successful Contractor requested to work during other than normal work hours of the license plate employees will be borne by the Contractor.
g) If new equipment is requested or proposed from either party during the term of this contract, and the equipment is not installed in the time and manner specified above, or if any sheeting, ink, or coating fails to meet specifications, the newly awarded contract is subject to cancellation and the agency reserves the right to purchase all sheeting, ink, or coating covered by the order from an alternate source, with the defaulting contractor reimbursing any cost differential.

2.4 Technical Support, Repairs, and Maintenance

The standard process to report a problem starts with a customer call to the Contractor CCE. The Contractor CCE is designed to be a central focal point and repository for all customer contact and problem resolution. Contractor CCE personnel have experience with reflective license plate sheeting. If a problem or question cannot be resolved at that level, the Contractor CCE staff has direct access to the necessary resources to solve the problem. This team is responsible for managing concerns/issues effectively and in a timely fashion. To reach the Contractor CCE, Michigan personnel can report issues to 1-877-777-3571, Option 1 between the hours of 7am-7pm EST.

Contractor defines standard response times based on a severity from 1 to 4, with Severity 1 being the most critical (i.e., production down) and Severity 4 being the least (i.e., system is functional with minor impact). Contractor response time for a Severity 1 is one hour for an initial response. For a Severity 4, the standard response time is two business days. Contractor's standards ensure all issues are handled consistently, escalated appropriately, and tracked so that all calls and responses are available for root cause and trend analysis and review.

Below is the detailed Technical Support Response Plan:

Steps to Resolution	Severity 1, Production Down	Severity 2-4
Customer contacts Contractor	Call Contractor Customer Support	Call Contractor Customer Support
Contractor contacts customer	Within one hour following initial call to Contractor Customer Support	From four hours to two days following initial call to Contractor Customer Support
Analyze problem	Contractor engineer analyzes the problem and corrects it remotely if possible	Contractor Engineer analyzes the problem and corrects it remotely if possible
Send in-stock replacement parts	Shipped overnight	Shipped in 2-4 days
Parts need to be ordered and sent	Shipped overnight	Shipped in 2-4 days
Installation of parts	Contractor provides telephone support to personnel during installation of the spare part(s)	Contractor provides telephone support to personnel during installation of the spare part(s)
If parts replacement fails - resolution plan	A resolution plan is communicated within one business day of initial call to Contractor	A resolution plan is communicated within one business day of initial call to Contractor
Software defect verified; workaround	If a workaround is available, it is implemented within one business day of the initial call to Contractor	If a workaround is available, it is implemented within one to three business days of the initial call to Contractor
Software defect fixed; solution installed	If no workaround is available, a solution is found and installed within two business days of initial call to Contractor	If no workaround is available, a solution is found and installed with the next scheduled release
Contractor engineer travels onsite	In the event that telephone support and remote service is deemed unsuccessful by Contractor, Contractor support personnel travel to the site within two business days	In the event that telephone support and remote service is deemed unsuccessful by Contractor, Contractor support personnel travel to the site within three to five business days

2.5 Maintenance

a) Contractor will be responsible for on-site maintenance of equipment and will be performed according to the recommended manufacturer maintenance schedule.

b) Maintenance will be performed by an authorized service rep and at no additional cost to the State.

2.6 Training

If necessary, Contractor will provide additional training throughout the term of the contract.

2.7 Reporting

a) Contractor will provide a Quarterly Usage Report that includes the agency and location and lists items ordered, dates, quantities, and pricing.

b) The State reserves the right to request additional reports as deemed necessary.

2.8 Meetings

The State may request meetings as it deems appropriate.

2.9 Plate Design Services

a) The reflective sheeting manufacturer shall have available a professional design service to assist the State in creating a license plate of high legibility, recognizability and desired aesthetics. The sheeting manufacturer will be required to furnish sheeting based on the current license plate design/format or any approved State design. Failure to match and maintain colors in accordance with this section may be cause for Contract cancellation under the provisions as outlined in the Standard Contract Terms section 23 and 24.

b) Special-plate-category designs shall be provided in standard roll form so that they can be manufactured into finished plates by the same process and on the same machinery as used for the basic design(s) covered by this Contract. The Contractor will provide these designs in quantities as limited as one 750 ft. roll of material.

c) At no cost to the State, the State reserves the right to redesign any or all of the plates required under these specifications during any resulting Contract period. Contractor will comply with this requirement for a design graphic service. Should the new design be a long-run graphic production, there will be a license plate set up fee of $3,000/color for cylinder engraving.

d) Artwork for graphic license plate designs given to the Contractor by the State in fulfillment of this Contract shall be the property of the State. This artwork shall be returned to the State within one week of the termination or expiration of the Contract. Internal artwork files developed by the Contractor to prepare the State graphic design for sheeting production remains the property of the Contractor.

2.10 Other Materials

In addition to the reflectorized sheeting which is being purchased, and the equipment which is being provided by the Contractor, the Contractor will supply, at no additional cost, all inks and/or process materials (excluding metal blanks) which will be required by the State to manufacture its finished products. The Contractor will supply, and update as necessary, all formulas that the State will require in order to mix the various inks required in the silk screening and manufacturing processes.

2.11 Hazardous Materials

The successful Contractor will be liable for all costs incurred for the removal and disposal of hazardous materials and waste products that result from the silk screening and manufacturing processes. The State reserves the right to arrange for the proper removal of these hazardous materials and have costs credited on invoices.

3. Staffing

3.1 Contractor Representative

The Contractor must appoint 1 individual, specifically assigned to State of Michigan accounts, that will respond to State inquiries regarding the Contract Activities, answering questions related to ordering and delivery, etc. (the "Contractor Representative").

For license plate sheeting contact Gerarda Tobin - Government Services Manager - (313) 575-4663

The Contractor must notify the Contract Administrator at least 30 calendar days before removing or assigning a new Contractor Representative.

3.2 Non-Key Personnel

The Contractor must notify the Contract Administrator at least 10 calendar days before removing or assigning non-key personnel.

3.3 Organizational Chart - Reserved

3.4 Customer Service Toll-Free Number

To reach customer service dial the toll free number 1-877-777-3571 and select option 1 when prompted between the hours of 7am-7pm EST.

3.6 Disclosure of Subcontractors

Contractor will not be utilizing subcontracts. If the Contractor would ever need to utilize subcontractors, the Contractor must disclose the following:

a) The legal business name; address; telephone number; a description of subcontractor's organization and the services it will provide; and information concerning subcontractor's ability to provide the Contract Activities.

b) The relationship of the subcontractor to the Contractor.

c) Whether the Contractor has a previous working experience with the subcontractor. If yes, provide the details of that previous relationship.

d) A complete description of the Contract Activities that will be performed or provided by the subcontractor.

3.7 Security

The Contractor will be subject to the following security procedures as required by the Department of Corrections. Current versions of these policies are available through the Program Manager.

a) Prison Rape Elimination Act (PREA).
b) The Department of Corrections Vendor Handbook.

The Contractor has additional security measures in place to ensure the security of State facilities. These include, but are not limited to, the following:

a) Contractor will issue ID badges to its employees.
b) The Contractor manufacturing plant located at Brownwood, Texas has an internal security system. A video security system monitors all exterior areas of the plant. Entrance to the facility is only permitted by submitting a coded identification badge presented to an electronic reader. That badge must be in full view whenever the Contractor employee is in the plant. Access to the plant by Contractor employees from other facilities and by non-Contractor employees is gained only through one gate monitored by a guard 24 hours a day, 7 days a week. If the individual entering the plant is not a Contractor employee, they must be accompanied by a Contractor escort during their visit. Supervision of the various product manufacturing areas are broken up under product managers, manufacturing operations supervisors, and department supervisors. Waste material that may be produced in the various manufacturing operations is sent to a secure landfill that is used for the disposal of Contractor products only.

4. Pricing

4.1 Price Term

Pricing is firm for a 365 day period ("Pricing Period"). The first pricing period begins on the Effective Date. Adjustments may be requested, in writing, by either party, for increases **OR** decreases, and will take effect no earlier than the next Pricing Period.

4.2 Price Changes

a) Adjustments will be based on changes in actual Contractor costs. Any request must be supported by written evidence documenting the change in costs. The State may consider sources, such as the Consumer Price Index; Producer Price Index; other pricing indices as needed; economic and industry data; manufacturer or supplier letters noting the increase in pricing; and any other data the State deems relevant.
b) Following the presentation of supporting documentation, both parties will have 30 days to review the information and prepare a written response. If the review reveals no need for modifications, pricing will remain unchanged unless mutually agreed to by the parties. If the review reveals that changes are needed, both parties will negotiate such changes, for no longer than 30 days, unless extended by mutual agreement.
c) The Contractor remains responsible for Contract Activities at the current price for all orders received before the mutual execution of a Change Notice indicating the start date of the new Pricing Period.

5. Ordering

5.1 Authorizing Document

The appropriate authorizing document for the Contract will be a Purchase Order, which must be approved by the Program Manager, to order any Deliverable(s). The Contractor is not authorized to begin performance until receipt of a Purchase Order.

5.2 Order Verification

The Contractor must have internal controls to verify abnormal orders and to ensure that only authorized individuals place orders.

The State will provide a list of approved personnel who are authorized to submit orders. Contractor will then set the State's account to only accept orders from those pre-approved individuals. Contractor's pricing system provides automation of contract pricing.

6. Delivery

6.1 Delivery Programs

a) Contractor ships F.O.B. Shipping Point. Transportation charges are pre-paid. Premium routed shipments are available upon request and may incur additional shipping costs. Orders are processed daily and shipped when ready.
b) Third party shipping carriers will be used for the supply of this contract that may include LTL, UPS, and FedEX.
c) The Contractor shall be accountable for all sheeting from the place of manufacture to the point of delivery. All over-run materials remaining in the manufacturer's possession after discontinuation of any design or the Contract's cancellation, shall be destroyed and used for no other purpose.

d) Engraved printing cylinders used to manufacture pre-printed sheeting shall be supplied and remain in the possession of the sheeting manufacturer until such time as the cylinders are destroyed.

6.2 Packaging and Palletizing

Packaging must be optimized to permit the lowest freight rate. Shipments must be palletized whenever possible using manufacturer's standard 4-way shipping pallets.

7. Acceptance

7.1 Acceptance, Inspection and Testing

The following criteria will be used by the State to determine Acceptance of the Services or Deliverables provided under this SOW to include sheeting and inks:

a) The State may inspect all the Deliverables proposed on the pricing sheet to confirm that all components have been delivered without material deficiencies. If the State determines that the Deliverable or one of its components has material deficiencies, the State may reject the Deliverable without performing any further inspection or testing.

b) The State will only approve a Deliverable after confirming that it conforms to and performs according to its specifications without material deficiency. The State may, in its discretion, conditionally approve a Deliverable that contains material deficiencies if the State elects to permit the Contractor to correct those deficiencies post-approval. The Contractor remains responsible for working diligently to correct, within 30 Days at the Contractor's expense, all deficiencies in the Deliverable that remain outstanding at the time of State approval.

c) The State, at any time, and in its reasonable discretion, may reject the Deliverable without notation of all deficiencies if the acceptance process reveals deficiencies in a sufficient quantity or of a sufficient severity that renders continuing the process unproductive or unworkable.

7.2 Final Acceptance

a) If new equipment is ever required or recommended from either party, final acceptance will be achieved once equipment is installed and tested based on manufacturer’s requirements and State of Michigan approval.

b) Installation and training shall be acceptable upon consistently running the required line(s) at representative speeds not to exceed 100 strokes per minute, with a rejection rate of 2% or less. The acceptability of the blanks shall be determined by materially conforming to the contract specifications.

c) The State Agency representative, or designee, will review and inspect order shipments and approve acceptance of goods upon delivery.

8. Invoice and Payment

8.1 Invoice Requirements

All invoices submitted to the State must include: (a) date; (b) purchase order/Contract Number; (c) quantity; (d) description of the Contract Activities; (e) unit price; (f) shipping cost (if any); and (g) total price.

8.2 Payment Methods

The State will make payment for Contract Activities by Electronic Funds Transfer (EFT).

9. Project Plan

If new equipment is ever required or recommended from either party, the Contractor will submit a written project plan to the Program Manager for approval. The plan must include: (a) the Contractor's organizational chart with names and title of personnel assigned to the project, which must align with the staffing stated in accepted proposals; (b) the project breakdown showing sub-projects, tasks, and resources required; (c) timeframe for completion; (d) the time-phased plan in the form of a graphic display, showing each event, task, and decision point in your work plan and (d) training schedule on new equipment.

10. Affirmation of Authorized Distributor

Contractor affirms that they are the manufacturer of 3M™ Preclear Reflective License Plate Sheeting with Ensure Image and Virtual Security Thread, 3M Road Sign Reflective Sheeting, and 3M Pavement Marking Tape. Contract agrees to notify the Contract Administrator of any changes.

11. Additional Requirements

11.1 Environmental and Energy Efficient Products

The Contractor must identify any energy efficient, bio-based, or otherwise environmental friendly products used in the products. Contractor must include any relevant third-party certification. There currently are no Contractor products applicable to this project that meet this requirement.

11.2 Recycled Content and Recyclability

Deliverable(s). Without compromising performance or quality, the State prefers Deliverable(s) containing higher percentages of recycled materials. The Contractor must indicate an estimate of the percentage of recycled materials, if any, contained in each Deliverable:

Total estimated percentage of recovered material	0%
Estimated percentage of post-consumer material	0%
Estimated percentage of post-industrial waste	0%

11.3 Hazardous Chemical Identification

a) In accordance with the federal Emergency Planning and Community Right-to-Know Act, 42 USC 11001, *et seq.*, as amended, the Contractor must provide a Material Safety Data Sheet listing any hazardous chemicals, as defined in 40 CFR §370.2, to be delivered. Each hazardous chemical must be properly identified, including any applicable identification number, such as a National Stock Number or Special Item Number.

b) The Contractor must identify any hazardous chemicals that will be provided under any resulting contract.

I. The Contractor Roll Coat Inks Series 4800/4900 and Contractor Roll Coat Inks Series 4850/4950 are considered to be hazardous chemicals.

11.4 Mercury Content

Pursuant to MCL 18.1261d, mercury-free products must be procured when possible. The Contractor must explain if it intends to provide products containing mercury, the amount or concentration of mercury, and whether cost competitive alternatives exist. If cost competitive alternatives do not exist, the Contractor must provide justification as to why the particular product is essential. All products containing mercury must be labeled as containing mercury. Current Contractor products being offered do not contain mercury.

11.5 Brominated Flame Retardants

The State prefers to purchase products that do not contain brominated flame retardants (BFRs) whenever possible. The Contractor must disclose whether the products contain BFRs. Current Contractor products being offered do not contain brominated flame retardants.

STATE OF MICHIGAN

EXHIBIT A 2

Road Sign Reflective Sheeting and Pavement Markers

STATEMENT OF WORK
CONTRACT ACTIVITIES

1. General Requirements

1.1 Product Specifications

Delivery of product as detailed in ***"Attachment A – Price Sheet"***.

1.2 Warranties

Please refer to ***"Attachment B - 3M Product Bulletins for Reflective Sheeting and Pavement Marking Tape"*** for complete warranty details.

1.3 Recall Requirements and Procedures

If a product recall is deemed, Contractor will immediately contact the Program Manager, Contract Administrator, and any customer affected by the recall and advise them by email and/or phone communication on the procedures at that time based on the circumstances.

1.4 Quality Assurance Program

Both Contractor's business and manufacturing sites for reflective sheeting and pavement marking products are certified to the ISO 9001:2008 standard by a third party agency. As part of this standard's certification, Contractor's quality management systems have been deemed to be both comprehensive and effective in supporting Contractor products, including reflective sign sheeting and pavement marking tapes.

1.5 Incentives

a) Contractor will offer a 2% 20 Net 30 terms discount as an incentive to the State of Michigan.

b) Because Contractor was awarded all three categories (License Plate Sheeting, Road Sign Reflective Sheeting, and Pavement Marking Tape), an additional 1% price discount will be applied and is reflected in ***"Attachment A – Price Sheet"***.

2. Service Levels

2.1 Delivery Time Frames

Contractor will deliver standard stocked items within 10 Days ARO and custom cut/make-to-order items within 20-30 Days ARO. If an exception occurs, Contractor will make every effort to advise of the particular scenario.

2.2 Technical Support and Repairs

The standard process to report a problem starts with a customer call to the Contractor CCE. The Contractor CCE is designed to be a central focal point and repository for all customer contact and problem resolution. Contractor CCE personnel have experience with reflective license plate sheeting. If a problem or question cannot be resolved at that level, the Contractor CCE staff has direct access to the necessary resources to solve the problem. This team is responsible for managing concerns/issues effectively and in a timely fashion. To reach the Contractor CCE, Michigan personnel can report issues to 1-877-777-3571, Option 1.

Contractor defines standard response times based on a severity from 1 to 4, with Severity 1 being the most critical (i.e., production down) and Severity 4 being the least (i.e., system is functional with minor impact). Contractor response time for a Severity 1 is one hour for an initial response. For a Severity 4, the standard response time is two business days. Contractor standards ensure all issues are handled consistently, escalated appropriately, and tracked so that all calls and responses are available for root cause and trend analysis and review.

Below is the detailed Technical Support Response Plan:

Steps to Resolution	Severity 1, Production Down	Severity 2-4
Customer contacts Contractor	Call Contractor Customer Support	Call Contractor Customer Support
Contractor contacts customer	Within one hour following initial call to Contractor Customer Support	From four hours to two days following initial call to Contractor Customer Support
Analyze problem	Contractor engineer analyzes the problem and corrects it remotely	Contractor Engineer analyzes the problem and corrects it remotely

	if possible	if possible
Send in-stock replacement parts	Shipped overnight	Shipped in 2-4 days
Parts need to be ordered and sent	Shipped overnight	Shipped in 2-4 days
Installation of parts	Contractor provides telephone support to personnel during installation of the spare part(s)	Contractor provides telephone support to personnel during installation of the spare part(s)
If parts replacement fails - resolution plan	A resolution plan is communicated within one business day of initial call to Contractor	A resolution plan is communicated within one business day of initial call to Contractor
Software defect verified; workaround	If a workaround is available, it is implemented within one business day of the initial call to Contractor	If a workaround is available, it is implemented within one to three business days of the initial call to Contractor
Software defect fixed; solution installed	If no workaround is available, a solution is found and installed within two business days of initial call to Contractor	If no workaround is available, a solution is found and installed with the next scheduled release
Contractor engineer travels onsite	In the event that telephone support and remote service is deemed unsuccessful by Contractor, Contractor support personnel travel to the site within two business days	In the event that telephone support and remote service is deemed unsuccessful by Contractor, Contractor support personnel travel to the site within three to five business days

For Graffiti Removal: Contractor recommends the use of the 1160 Premium Protective Overlay Film for graffiti protection of reflective signs. Otherwise, it is recommended to contact the Contractor TSSD Technical Service Line at 800-553-1380 between the hours of 7am-7pm EST, Option 4 for the best removal recommendations based on the type of graffiti and Contractor Material to be cleaned.

2.3 Training

The Contractor Local Sales Representative shall provide assistance with training or setup all necessary on-site training for the production of signs utilizing Contractor sign sheeting materials. Additionally, Contractor TSSD Technical Support is available via phone at 800-553-1380, Option 4.

2.4 Reporting

a) Quarterly usage reports to include agency, location, order date, item ordered, contract list price, and extended price.

b) Contractor's reports that might give insight on their product and/or equipment improvements.

The State reserves the right to request additional reports as deemed necessary.

2.5 Meetings

The State may request meetings as it deems appropriate.

3. Staffing

3.1 Contractor Representative

The Contractor must appoint individuals, specifically assigned to State of Michigan accounts, that will respond to State inquiries regarding the Contract Activities, answering questions related to ordering and delivery, etc. (the "Contractor Representative").

I. Matt Leibel (Contract Administrator) 651-737-8279
II. Contractor TSSD Customer Service (Orders) 800-553-1380, Option 1
III. Brad Stone (Local Sales Rep) 248-277-8347

The Contractor must notify the Contract Administrator at least **30** calendar days before removing or assigning a new Contractor Representative.

3.2 Non-Key Personnel
The Contractor must notify the Contract Administrator at least **10** calendar days before removing or assigning non-key personnel.

3.3 Organizational Chart - Reserved

4. Pricing
4.1 Price Term
Pricing is firm for a 365 day period ("Pricing Period"). The first pricing period begins on the Effective Date. Adjustments may be requested, in writing, by either party, for increases **OR** decreases, and will take effect no earlier than the next Pricing Period.

4.2 Price Changes
a) Adjustments will be based on changes in actual Contractor costs. Any request must be supported by written evidence documenting the change in costs. The State may consider sources, such as the Consumer Price Index; Producer Price Index; other pricing indices as needed; economic and industry data; manufacturer or supplier letters noting the increase in pricing; and any other data the State deems relevant.
b) Following the presentation of supporting documentation, both parties will have 30 days to review the information and prepare a written response. If the review reveals no need for modifications, pricing will remain unchanged unless mutually agreed to by the parties. If the review reveals that changes are needed, both parties will negotiate such changes, for no longer than 30 days, unless extended by mutual agreement.
c) The Contractor remains responsible for Contract Activities at the current price for all orders received before the mutual execution of a Change Notice indicating the start date of the new Pricing Period.

5. Ordering
5.1 Authorizing Document
The appropriate authorizing document for the Contract will be a Purchase Order, which must be approved by the Program Manager, to order any Deliverable(s). The Contractor is not authorized to begin performance until receipt of a Purchase Order.

5.2 Order Verification
The Contractor must have internal controls to verify abnormal orders and to ensure that only authorized individuals place orders.

6. Delivery
6.1 Delivery Programs
a) Delivery shall be to the location address listed on the purchase order.
b) Third party shipping carriers will be used for the supply of this contract that may include LTL, UPS, and FedEx.

6.2 Packaging and Palletizing
a) Packaging and containers must meet the current requirements of state and federal law applicable to rail and motor carrier freight classifications, which will permit application of the lowest freight rate.
b) Packaging must be optimized to permit the lowest freight rate. Freight is prepaid for standard ground shipping.

7. Acceptance
7.1 Acceptance, Inspection and Testing

The following criteria will be used by the State to determine Acceptance of the Services or Deliverables provided under this SOW:

a) The State may inspect the Deliverable to confirm that all components have been delivered without material deficiencies. If the State determines that the Deliverable or one of its components has material deficiencies, the State may reject the Deliverable without performing any further inspection or testing.
b) The State will only approve a Deliverable after confirming that it conforms to and performs according to its specifications without material deficiency. The State may, in its discretion, conditionally approve a Deliverable that contains material deficiencies if the State elects to permit the Contractor to correct those deficiencies post-approval. The Contractor remains responsible for working diligently to correct, within 30 Days at the Contractor's expense, all deficiencies in the Deliverable that remain outstanding at the time of State approval.
c) The State, at any time and in its reasonable discretion, may reject the Deliverable without notation of all deficiencies if the acceptance process reveals deficiencies in a sufficient quantity or of a sufficient severity that renders continuing the process unproductive or unworkable.

8. Invoice and Payment

8.1 Invoice Requirements

All invoices submited to the State must include: (a) date; (b) purchase order; (c) quantity; (d) description of the Contract Activities; (e) unit price; (f) shipping cost (if any); and (g) total price.

8.2 Payment Methods

The State will make payment for approved/accepted Contract Activities by Electronic Funds Transfer (EFT).

9. Additional Requirements

9.1 Environmental and Energy Efficient Products

The Contractor must identify any energy efficient, bio-based, or otherwise environmental friendly products used in the products. Contractor must include any relevant third-party certification. Contractor currently has no products applicable to this project that meet this requirement.

9.2 Recycled Content and Recyclability

Deliverable(s). Without compromising performance or quality, the State prefers Deliverable(s) containing higher percentages of recycled materials. The Contractor must indicate an estimate of the percentage of recycled materials, if any, contained in each Deliverable:

a)	Total estimated percentage of recovered material	**0%**
b)	Estimated percentage of post-consumer material	**0%**
c)	Estimated percentage of post-industrial waste	**0%**

9.3 Hazardous Chemical Identification

In accordance with the federal Emergency Planning and Community Right-to-Know Act, 42 USC 11001, *et seq.*, as amended, the Contractor must provide a Material Safety Data Sheet listing any hazardous chemicals, as defined in 40 CFR §370.2, to be delivered. Each hazardous chemical must be properly identified, including any applicable identification number, such as a National Stock Number or Special Item Number.

The Contractor Process Color 880I Ink Series is considered to be a hazardous chemical. Please see attached MSDS sheet for complete details of hazardous chemicals.

9.4 Mercury Content

Pursuant to MCL 18.1261d, mercury-free products must be procured when possible. The Contractor must explain if it intends to provide products containing mercury, the amount or concentration of mercury, and whether cost competitive alternatives exist. If cost competitive alternatives do not exist, the Contractor must provide justification as to why the particular product is essential. All products containing mercury must be labeled as containing mercury. Contractor currently has no products being offered that contain mercury.

9.5 Brominated Flame Retardants

The State prefers to purchase products that do not contain brominated flame retardants (BFRs) whenever possible. The Contractor must disclose whether the products contain BFRs. Contractor currently has no products being offered that contain brominated flame retardants.

3M Traffic Safety and Security Division
3M Center Building 225-4N-14
St. Paul, MN 55144-1000
FAX: 1-800-591-9293
Toll Free 1-800-553-1380

To: MI DEPT TRANSPORTATION
REFLECTIVE SYSTEMS UNIT
(MDF3584)
425 W OTTAWA ST
LANSING, MI 48933-1532

From: Matt Leibel, tbidgroup@mmm.com
Phone: 651-737-8279

Quotation Number: MSBC15091566
MI DOT CONTRACT: 00711480002136
Quotation Date: Nov 19, 2015
Expiration Date*: Jan 18, 2016
Terms: 2% 20 NET 30
Delivery Time:
F.O.B: See Below

REFLECTIVE SIGN SHEETING & PAVEMENT MARKING PRODUCTS

SQFT Priced Items:

Description	Width	Length	Area	Price	SQFT Price
Electronic Cuttable Film 1170 NonPunche	6in	50yds	75.000	$52.65	0.7020
Electronic Cuttable Film 1170 NonPunche	9in	50yds	112.500	$78.98	0.7020
Electronic Cuttable Film 1170 NonPunche	12in	50yds	150.000	$105.30	0.7020
Electronic Cuttable Film 1170 NonPunche	12.75in	50yds	159.375	$111.88	0.7020
Electronic Cuttable Film 1170 NonPunche	15in	50yds	187.500	$131.63	0.7020
Electronic Cuttable Film 1170 NonPunche	18in	50yds	225.000	$157.95	0.7020
Electronic Cuttable Film 1170 NonPunche	24in	50yds	300.000	$210.60	0.7020
Electronic Cuttable Film 1170 NonPunche	30in	50yds	375.000	$263.25	0.7020
Electronic Cuttable Film 1170 NonPunche	36in	50yds	450.000	$315.90	0.7020
Electronic Cuttable Film 1170 NonPunche	48in	50yds	600.000	$421.20	0.7020
3334/3336 Barricade (Full Series, R/L)	6in	50yds	75.000	$89.10	1.1880
3334/3336 Barricade (Full Series, R/L)	7in	50yds	87.500	$103.95	1.1880
3334/3336 Barricade (Full Series, R/L)	7.75in	50yds	96.875	$115.09	1.1880
3334/3336 Barricade (Full Series, R/L)	8in	50yds	100.000	$118.80	1.1880
3334/3336 Barricade (Full Series, R/L)	10in	50yds	125.000	$148.50	1.1880
3334/3336 Barricade (Full Series, R/L)	11.75in	50yds	146.875	$174.49	1.1880
3334/3336 Barricade (Full Series, R/L)	12in	50yds	150.000	$178.20	1.1880
3334/3336 Barricade (Full Series, R/L)	24in	50yds	300.000	$356.40	1.1880
3430 White EGPS (3430					

Series)	6in	50yds	75.000	$45.98	0.6130
3430 White EGPS (3430 Series)	9in	50yds	112.500	$68.96	0.6130
3430 White EGPS (3430 Series)	12in	50yds	150.000	$91.95	0.6130
3430 White EGPS (3430 Series)	15in	50yds	187.500	$114.94	0.6130
3430 White EGPS (3430 Series)	18in	50yds	225.000	$137.93	0.6130
3430 White EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3430 White EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3430 White EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3430 White EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
3431 Yellow EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3431 Yellow EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3431 Yellow EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3431 Yellow EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
3432 Red EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3432 Red EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3432 Red EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3432 Red EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
3434 Orange EG Prismatic Shtg	0.5in	50yds	6.250	$3.83	0.6130
3434 Orange EG Prismatic Shtg	0.625in	50yds	7.813	$4.79	0.6130
3434 Orange EG Prismatic Shtg	0.75in	50yds	9.375	$5.75	0.6130
3434 Orange EG Prismatic Shtg	1in	50yds	12.500	$7.66	0.6130
3434 Orange EG Prismatic Shtg	1.25in	50yds	15.625	$9.58	0.6130
3434 Orange EG Prismatic Shtg	2in	50yds	25.000	$15.33	0.6130
3434 Orange EG Prismatic Shtg	3in	50yds	37.500	$22.99	0.6130
3434 Orange EG Prismatic Shtg	4in	50yds	50.000	$30.65	0.6130
3434 Orange EG Prismatic Shtg	6in	50yds	75.000	$45.98	0.6130
3434 Orange EG Prismatic Shtg	6.75in	50yds	84.375	$51.72	0.6130
3434 Orange EG Prismatic Shtg	8in	50yds	100.000	$61.30	0.6130
3434 Orange EG Prismatic Shtg	9in	50yds	112.500	$68.96	0.6130

3434 Orange EG Prismatic Shtg	12in	50yds	150.000	$91.95	0.6130
3434 Orange EG Prismatic Shtg	12.75in	50yds	159.375	$97.70	0.6130
3434 Orange EG Prismatic Shtg	15in	50yds	187.500	$114.94	0.6130
3434 Orange EG Prismatic Shtg	18in	50yds	225.000	$137.93	0.6130
3434 Orange EG Prismatic Shtg	24in	50yds	300.000	$183.90	0.6130
3434 Orange EG Prismatic Shtg	30in	50yds	375.000	$229.88	0.6130
3434 Orange EG Prismatic Shtg	36in	50yds	450.000	$275.85	0.6130
3434 Orange EG Prismatic Shtg	42in	50yds	525.000	$321.83	0.6130
3434 Orange EG Prismatic Shtg	48in	50yds	600.000	$367.80	0.6130
3435 Blue EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3435 Blue EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3435 Blue EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3435 Blue EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
3437 Green EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3437 Green EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3437 Green EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3437 Green EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
3439 Brown EGPS (3430 Series)	24in	50yds	300.000	$183.90	0.6130
3439 Brown EGPS (3430 Series)	30in	50yds	375.000	$229.88	0.6130
3439 Brown EGPS (3430 Series)	36in	50yds	450.000	$275.85	0.6130
3439 Brown EGPS (3430 Series)	48in	50yds	600.000	$367.80	0.6130
Scotchcal Film 3650-12/114 Black/Trnsp.	0.375in	50yds	4.688	$3.67	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	0.5in	50yds	6.250	$4.89	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	0.5625in	50yds	7.031	$5.50	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	0.625in	50yds	7.813	$6.11	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	0.75in	50yds	9.375	$7.33	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	0.875in	50yds	10.938	$8.55	0.7820
Scotchcal Film 3650-12/114 Black/Trnsp.	1in	50yds	12.500	$9.78	0.7820
Scotchcal Film 3650-12/114	1.25in	50yds	15.625	$12.22	0.7820

Black/Trnsp.					
Scotchcal Film 3650-12/114 Black/Trnsp.	1.5in	50yds	18.750	$14.66	0.7820
Scotchcal Plus Film Series 3690	1in	50yds	12.500	$7.30	0.5840
Scotchcal Plus Film Series 3690	1.25in	50yds	15.625	$9.13	0.5840
Scotchcal Plus Film Series 3690	2in	50yds	25.000	$14.60	0.5840
Scotchcal Plus Film Series 3690	3in	50yds	37.500	$21.90	0.5840
Scotchcal Plus Film Series 3690	4in	50yds	50.000	$29.20	0.5840
Scotchcal Plus Film Series 3690	5in	50yds	62.500	$36.50	0.5840
Scotchcal Plus Film Series 3690	6in	50yds	75.000	$43.80	0.5840
Scotchcal Plus Film Series 3690	7in	50yds	87.500	$51.10	0.5840
Scotchcal Plus Film Series 3690	8in	50yds	100.000	$58.40	0.5840
Scotchcal Plus Film Series 3690	9in	50yds	112.500	$65.70	0.5840
Scotchcal Plus Film Series 3690	10in	50yds	125.000	$73.00	0.5840
Scotchcal Plus Film Series 3690	11in	50yds	137.500	$80.30	0.5840
Scotchcal Plus Film Series 3690	12in	50yds	150.000	$87.60	0.5840
Scotchcal Plus Film Series 3690	13in	50yds	162.500	$94.90	0.5840
Scotchcal Plus Film Series 3690	14in	50yds	175.000	$102.20	0.5840
Scotchcal Plus Film Series 3690	15in	50yds	187.500	$109.50	0.5840
Scotchcal Plus Film Series 3690	16in	50yds	200.000	$116.80	0.5840
Scotchcal Plus Film Series 3690	17in	50yds	212.500	$124.10	0.5840
Scotchcal Plus Film Series 3690	18in	50yds	225.000	$131.40	0.5840
Scotchcal Plus Film Series 3690	19in	50yds	237.500	$138.70	0.5840
Scotchcal Plus Film Series 3690	20in	50yds	250.000	$146.00	0.5840
Scotchcal Plus Film Series 3690	21in	50yds	262.500	$153.30	0.5840
Scotchcal Plus Film Series 3690	22in	50yds	275.000	$160.60	0.5840
Scotchcal Plus Film Series 3690	23in	50yds	287.500	$167.90	0.5840
Scotchcal Plus Film Series 3690	24in	50yds	300.000	$175.20	0.5840
Scotchcal Plus Film Series					

3690	24in	100yds	600.000	$350.40	0.5840
Scotchcal Plus Film Series 3690	25in	50yds	312.500	$182.50	0.5840
Scotchcal Plus Film Series 3690	26in	50yds	325.000	$189.80	0.5840
Scotchcal Plus Film Series 3690	27in	50yds	337.500	$197.10	0.5840
Scotchcal Plus Film Series 3690	28in	50yds	350.000	$204.40	0.5840
Scotchcal Plus Film Series 3690	29in	50yds	362.500	$211.70	0.5840
Scotchcal Plus Film Series 3690	30in	50yds	375.000	$219.00	0.5840
Scotchcal Plus Film Series 3690	31in	50yds	387.500	$226.30	0.5840
Scotchcal Plus Film Series 3690	32in	50yds	400.000	$233.60	0.5840
Scotchcal Plus Film Series 3690	33in	50yds	412.500	$240.90	0.5840
Scotchcal Plus Film Series 3690	34in	50yds	425.000	$248.20	0.5840
Scotchcal Plus Film Series 3690	35in	50yds	437.500	$255.50	0.5840
Scotchcal Plus Film Series 3690	36in	50yds	450.000	$262.80	0.5840
Scotchcal Plus Film Series 3690	36in	100yds	900.000	$525.60	0.5840
Scotchcal Plus Film Series 3690	37in	50yds	462.500	$270.10	0.5840
Scotchcal Plus Film Series 3690	38in	50yds	475.000	$277.40	0.5840
Scotchcal Plus Film Series 3690	39in	50yds	487.500	$284.70	0.5840
Scotchcal Plus Film Series 3690	40in	50yds	500.000	$292.00	0.5840
Scotchcal Plus Film Series 3690	41in	50yds	512.500	$299.30	0.5840
Scotchcal Plus Film Series 3690	42in	50yds	525.000	$306.60	0.5840
Scotchcal Plus Film Series 3690	43in	50yds	537.500	$313.90	0.5840
Scotchcal Plus Film Series 3690	44in	50yds	550.000	$321.20	0.5840
Scotchcal Plus Film Series 3690	45in	50yds	562.500	$328.50	0.5840
Scotchcal Plus Film Series 3690	46in	50yds	575.000	$335.80	0.5840
Scotchcal Plus Film Series 3690	47in	50yds	587.500	$343.10	0.5840
Scotchcal Plus Film Series 3690	48in	50yds	600.000	$350.40	0.5840
Scotchcal Plus Film Series 3690	48in	100yds	1,200.000	$700.80	0.5840
3924S Fl. Orange DG Shtg					

WorkZone	6in	50yds	75.000	$111.38	1.4850
3924S Fl. Orange DG Shtg WorkZone	9in	50yds	112.500	$167.06	1.4850
3924S Fl. Orange DG Shtg WorkZone	12in	50yds	150.000	$222.75	1.4850
3924S Fl. Orange DG Shtg WorkZone	15in	50yds	187.500	$278.44	1.4850
3924S Fl. Orange DG Shtg WorkZone	18in	50yds	225.000	$334.13	1.4850
3924S Fl. Orange DG Shtg WorkZone	24in	50yds	300.000	$445.50	1.4850
3924S Fl. Orange DG Shtg WorkZone	30in	50yds	375.000	$556.88	1.4850
3924S Fl. Orange DG Shtg WorkZone	36in	50yds	450.000	$668.25	1.4850
3930 Wht High Intensity Prismatic	6in	50yds	75.000	$60.83	0.8110
3930 Wht High Intensity Prismatic	9in	50yds	112.500	$91.24	0.8110
3930 Wht High Intensity Prismatic	12in	50yds	150.000	$121.65	0.8110
3930 Wht High Intensity Prismatic	18in	50yds	225.000	$182.48	0.8110
3930 Wht High Intensity Prismatic	24in	50yds	300.000	$243.30	0.8110
3930 Wht High Intensity Prismatic	30in	50yds	375.000	$304.13	0.8110
3930 Wht High Intensity Prismatic	36in	50yds	450.000	$364.95	0.8110
3930 Wht High Intensity Prismatic	48in	50yds	600.000	$486.60	0.8110
3935 Blue HIP (3930 Series)	12.75in	50yds	159.375	$129.25	0.8110
3935 Blue HIP (3930 Series)	24in	50yds	300.000	$243.30	0.8110
3935 Blue HIP (3930 Series)	30in	50yds	375.000	$304.13	0.8110
3935 Blue HIP (3930 Series)	36in	50yds	450.000	$364.95	0.8110
3935 Blue HIP (3930 Series)	48in	50yds	600.000	$486.60	0.8110
3937 Green HIP (3930 Series)	12.75in	50yds	159.375	$129.25	0.8110
3937 Green HIP (3930 Series)	24in	50yds	300.000	$243.30	0.8110
3937 Green HIP (3930 Series)	30in	50yds	375.000	$304.13	0.8110
3937 Green HIP (3930 Series)	36in	50yds	450.000	$364.95	0.8110
3937 Green HIP (3930 Series)	48in	50yds	600.000	$486.60	0.8110
3939 Brown HIP (3930 Series)	12.75in	50yds	159.375	$129.25	0.8110
3939 Brown HIP (3930 Series)	24in	50yds	300.000	$243.30	0.8110
3939 Brown HIP (3930 Series)	30in	50yds	375.000	$304.13	0.8110
3939 Brown HIP (3930 Series)	36in	50yds	450.000	$364.95	0.8110
3939 Brown HIP (3930 Series)	48in	50yds	600.000	$486.60	0.8110
Fluor Ylw Diamond Grade VIP Shtg (3981)	12.75in	50yds	159.375	$228.70	1.4350
Fluor Ylw Diamond Grade VIP Shtg (3981)	24in	50yds	300.000	$430.50	1.4350
Fluor Ylw Diamond Grade VIP Shtg (3981)	30in	50yds	375.000	$538.13	1.4350
Fluor Ylw Diamond Grade VIP					

Shtg (3981)	36in	50yds	450.000	$645.75	1.4350
Fluor Ylw Diamond Grade VIP Shtg (3981)	48in	50yds	600.000	$861.00	1.4350
Fluro YlGrn Diamond Grade VIP Shtg 3983	24in	50yds	300.000	$430.50	1.4350
Fluro YlGrn Diamond Grade VIP Shtg 3983	30in	50yds	375.000	$538.13	1.4350
Fluro YlGrn Diamond Grade VIP Shtg 3983	36in	50yds	450.000	$645.75	1.4350
Fluro YlGrn Diamond Grade VIP Shtg 3983	48in	50yds	600.000	$861.00	1.4350
Diamond Grade VIP 3990 White	24in	50yds	300.000	$430.50	1.4350
Diamond Grade VIP 3990 White	30in	50yds	375.000	$538.13	1.4350
Diamond Grade VIP 3990 White	36in	50yds	450.000	$645.75	1.4350
Diamond Grade VIP 3990 White	48in	50yds	600.000	$861.00	1.4350
Diamond Grade VIP 3991 Yellow	12.75in	50yds	159.375	$228.70	1.4350
Diamond Grade VIP 3991 Yellow	24in	50yds	300.000	$430.50	1.4350
Diamond Grade VIP 3991 Yellow	30in	50yds	375.000	$538.13	1.4350
Diamond Grade VIP 3991 Yellow	36in	50yds	450.000	$645.75	1.4350
Diamond Grade VIP 3991 Yellow	48in	50yds	600.000	$861.00	1.4350
Diamond Grade VIP 3992 Red	6in	50yds	75.000	$107.63	1.4350
Diamond Grade VIP 3992 Red	18in	50yds	225.000	$322.88	1.4350
Diamond Grade VIP 3992 Red	24in	50yds	300.000	$430.50	1.4350
Diamond Grade VIP 3992 Red	30in	50yds	375.000	$538.13	1.4350
Diamond Grade VIP 3992 Red	36in	50yds	450.000	$645.75	1.4350
Diamond Grade VIP 3992 Red	48in	50yds	600.000	$861.00	1.4350
Diamond Grade VIP 3995 Blue	12.75in	50yds	159.375	$228.70	1.4350
Diamond Grade VIP 3995 Blue	24in	50yds	300.000	$430.50	1.4350
Diamond Grade VIP 3995 Blue	30in	50yds	375.000	$538.13	1.4350
Diamond Grade VIP 3995 Blue	36in	50yds	450.000	$645.75	1.4350
Diamond Grade VIP 3995 Blue	48in	50yds	600.000	$861.00	1.4350
Diamond Grade VIP 3997 Green	12.75in	50yds	159.375	$228.70	1.4350
Diamond Grade VIP 3997 Green	24in	50yds	300.000	$430.50	1.4350
Diamond Grade VIP 3997 Green	30in	50yds	375.000	$538.13	1.4350
Diamond Grade VIP 3997 Green	36in	50yds	450.000	$645.75	1.4350
Diamond Grade VIP 3997 Green	48in	50yds	600.000	$861.00	1.4350
4081 Fluorescent Yellow DG Cubed Refl	6in	50yds	75.000	$170.78	2.2770
4081 Fluorescent Yellow DG					

Cubed Refl	12.75in	50yds	159.375	$362.90	2.2770
4081 Fluorescent Yellow DG Cubed Refl	18in	50yds	225.000	$512.33	2.2770
4081 Fluorescent Yellow DG Cubed Refl	24in	50yds	300.000	$683.10	2.2770
4081 Fluorescent Yellow DG Cubed Refl	30in	50yds	375.000	$853.88	2.2770
4081 Fluorescent Yellow DG Cubed Refl	36in	50yds	450.000	$1,024.65	2.2770
4081 Fluorescent Yellow DG Cubed Refl	48in	50yds	600.000	$1,366.20	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	6in	50yds	75.000	$170.78	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	12in	50yds	150.000	$341.55	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	24in	50yds	300.000	$683.10	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	30in	50yds	375.000	$853.88	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	36in	50yds	450.000	$1,024.65	2.2770
4083 Fluorescent Ylw-Grn DG Cubed Refl	48in	50yds	600.000	$1,366.20	2.2770
4090 White DG Cubed Refl Shtg	9in	50yds	112.500	$256.16	2.2770
4090 White DG Cubed Refl Shtg	12in	50yds	150.000	$341.55	2.2770
4090 White DG Cubed Refl Shtg	18in	50yds	225.000	$512.33	2.2770
4090 White DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4090 White DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770
4090 White DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4090 White DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4090 White DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
4091 Yellow DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4091 Yellow DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770
4091 Yellow DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4091 Yellow DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4091 Yellow DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
4092 Red DG Cubed Refl Shtg	6in	50yds	75.000	$170.78	2.2770
4092 Red DG Cubed Refl Shtg	18in	50yds	225.000	$512.33	2.2770
4092 Red DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4092 Red DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770

4092 Red DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4092 Red DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4092 Red DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
4095 Blue DG Cubed Refl Shtg	12.75in	50yds	159.375	$362.90	2.2770
4095 Blue DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4095 Blue DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770
4095 Blue DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4095 Blue DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4095 Blue DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
4097 Green DG Cubed Refl Shtg	12.75in	50yds	159.375	$362.90	2.2770
4097 Green DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4097 Green DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770
4097 Green DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4097 Green DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4097 Green DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
4099 Brown DG Cubed Refl Shtg	12.75in	50yds	159.375	$362.90	2.2770
4099 Brown DG Cubed Refl Shtg	24in	50yds	300.000	$683.10	2.2770
4099 Brown DG Cubed Refl Shtg	30in	50yds	375.000	$853.88	2.2770
4099 Brown DG Cubed Refl Shtg	36in	50yds	450.000	$1,024.65	2.2770
4099 Brown DG Cubed Refl Shtg	42in	50yds	525.000	$1,195.43	2.2770
4099 Brown DG Cubed Refl Shtg	48in	50yds	600.000	$1,366.20	2.2770
444L 4in Lft Barc. DG3 (444/446 Series)	6in	50yds	75.000	$172.20	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	7in	50yds	87.500	$200.90	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	7.75in	50yds	96.875	$222.43	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	8in	50yds	100.000	$229.60	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	10in	50yds	125.000	$287.00	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	11.75in	50yds	146.875	$337.23	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	12in	50yds	150.000	$344.40	2.2960
444L 4in Lft Barc. DG3 (444/446 Series)	24in	50yds	300.000	$688.80	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	6in	50yds	75.000	$172.20	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	7in	50yds	87.500	$200.90	2.2960

444R 4in Rt Barc. DG3 (444/446 Series)	7.75in	50yds	96.875	$222.43	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	8in	50yds	100.000	$229.60	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	10in	50yds	125.000	$287.00	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	11.75in	50yds	146.875	$337.23	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	12in	50yds	150.000	$344.40	2.2960
444R 4in Rt Barc. DG3 (444/446 Series)	24in	50yds	300.000	$688.80	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	6in	50yds	75.000	$172.20	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	7in	50yds	87.500	$200.90	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	7.75in	50yds	96.875	$222.43	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	8in	50yds	100.000	$229.60	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	10in	50yds	125.000	$287.00	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	11.75in	50yds	146.875	$337.23	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	12in	50yds	150.000	$344.40	2.2960
446L 6in Lft Barc. DG3 (444/446 Series)	24in	50yds	300.000	$688.80	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	6in	50yds	75.000	$172.20	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	7in	50yds	87.500	$200.90	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	7.75in	50yds	96.875	$222.43	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	8in	50yds	100.000	$229.60	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	10in	50yds	125.000	$287.00	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	11.75in	50yds	146.875	$337.23	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	12in	50yds	150.000	$344.40	2.2960
446R 6in Rt Barc. DG3 (444/446 Series)	24in	50yds	300.000	$688.80	2.2960
Advanced EGP 7930 White	18in	50yds	225.000	$133.65	0.5940
Advanced EGP 7930 White	24in	50yds	300.000	$178.20	0.5940
Advanced EGP 7930 White	30in	50yds	375.000	$222.75	0.5940
Advanced EGP 7930 White	36in	50yds	450.000	$267.30	0.5940
Advanced EGP 7930 White	48in	50yds	600.000	$356.40	0.5940
Advanced EGP 7931 Yellow	24in	50yds	300.000	$178.20	0.5940
Advanced EGP 7931 Yellow	30in	50yds	375.000	$222.75	0.5940
Advanced EGP 7931 Yellow	36in	50yds	450.000	$267.30	0.5940
Advanced EGP 7931 Yellow	48in	50yds	600.000	$356.40	0.5940

Advance EGP 7932 Red	24in	50yds	300.000	$178.20	0.5940
Advance EGP 7932 Red	30in	50yds	375.000	$222.75	0.5940
Advance EGP 7932 Red	36in	50yds	450.000	$267.30	0.5940
Advance EGP 7932 Red	48in	50yds	600.000	$356.40	0.5940
Advance EGP 7934 Orange	24in	50yds	300.000	$178.20	0.5940
Advance EGP 7934 Orange	30in	50yds	375.000	$222.75	0.5940
Advance EGP 7934 Orange	36in	50yds	450.000	$267.30	0.5940
Advance EGP 7934 Orange	48in	50yds	600.000	$356.40	0.5940
Advanced EGP 7935 Blue	24in	50yds	300.000	$178.20	0.5940
Advanced EGP 7935 Blue	30in	50yds	375.000	$222.75	0.5940
Advanced EGP 7935 Blue	36in	50yds	450.000	$267.30	0.5940
Advanced EGP 7935 Blue	48in	50yds	600.000	$356.40	0.5940
Advanced EGP 7937 Green	24in	50yds	300.000	$178.20	0.5940
Advanced EGP 7937 Green	30in	50yds	375.000	$222.75	0.5940
Advanced EGP 7937 Green	36in	50yds	450.000	$267.30	0.5940
Advanced EGP 7937 Green	48in	50yds	600.000	$356.40	0.5940
7939 Brn Advnaced EGP	24in	50yds	300.000	$178.20	0.5940
7939 Brn Advnaced EGP	30in	50yds	375.000	$222.75	0.5940
7939 Brn Advnaced EGP	36in	50yds	450.000	$267.30	0.5940
7939 Brn Advnaced EGP	48in	50yds	600.000	$356.40	0.5940
Diamond Grade Conspicuity White/Red/Ylw	2in	50yds	25.000	$54.45	2.1780
Diamond Grade Conspicuity White/Red/Ylw	3in	50yds	37.500	$81.68	2.1780
Diamond Grade Conspicuity White/Red/Ylw	4in	50yds	50.000	$108.90	2.1780
Stamark A270ES Series Tape	4in	30yds	30.000	$68.31	2.2770
Stamark A270ES Series Tape	4in	100yds	100.000	$227.70	2.2770
Stamark A270ES Series Tape	6in	30yds	45.000	$102.47	2.2770
Stamark A270ES Series Tape	6in	100yds	150.000	$341.55	2.2770
Stamark A270ES Series Tape	8in	30yds	60.000	$136.62	2.2770
Stamark A270ES Series Tape	12in	30yds	90.000	$204.93	2.2770
Stamark A270ES Series Tape	16in	30yds	120.000	$273.24	2.2770
Stamark A270ES Series Tape	18in	30yds	135.000	$307.40	2.2770
Stamark A270ES Series Tape	24in	30yds	180.000	$409.86	2.2770
Stamark A270ES Series Tape	36in	30yds	270.000	$614.79	2.2770
Stamark A270ES Series Tape	48in	20yds	240.000	$546.48	2.2770
Stamark A380IES WHITE	4in	30yds	30.000	$118.80	3.9600
Stamark A380IES WHITE	4in	100yds	100.000	$396.00	3.9600
Stamark A380IES WHITE	5in	30yds	37.500	$148.50	3.9600
Stamark A380IES WHITE	5in	100yds	125.000	$495.00	3.9600
Stamark A380IES WHITE	6in	30yds	45.000	$178.20	3.9600
Stamark A380IES WHITE	6in	100yds	150.000	$594.00	3.9600
Stamark A380IES WHITE	8in	30yds	60.000	$237.60	3.9600
Stamark A380IES WHITE	8in	80yds	160.000	$633.60	3.9600
Stamark A380IES WHITE	10in	30yds	75.000	$297.00	3.9600
Stamark A380IES WHITE	12in	30yds	90.000	$356.40	3.9600
Stamark A380IES WHITE	16in	30yds	120.000	$475.20	3.9600
Stamark A380IES WHITE	18in	30yds	135.000	$534.60	3.9600
Stamark A380IES WHITE	24in	30yds	180.000	$712.80	3.9600
Stamark A380IES WHITE	48in	20yds	240.000	$950.40	3.9600

Stamark A381IES Yellow	4in	30yds	30.000	$118.80	3.9600
Stamark A381IES Yellow	4in	100yds	100.000	$396.00	3.9600
Stamark A381IES Yellow	5in	30yds	37.500	$148.50	3.9600
Stamark A381IES Yellow	5in	100yds	125.000	$495.00	3.9600
Stamark A381IES Yellow	6in	30yds	45.000	$178.20	3.9600
Stamark A381IES Yellow	6in	100yds	150.000	$594.00	3.9600
Stamark A381IES Yellow	8in	30yds	60.000	$237.60	3.9600
Stamark A381IES Yellow	8in	80yds	160.000	$633.60	3.9600
Stamark A381IES Yellow	10in	30yds	75.000	$297.00	3.9600
Stamark A381IES Yellow	12in	30yds	90.000	$356.40	3.9600
Stamark A381IES Yellow	24in	30yds	180.000	$712.80	3.9600
Stamark A381IES Yellow	48in	20yds	240.000	$950.40	3.9600
A710 Wet Refl Removable Stamark	4in	40yds	40.000	$77.20	1.9300
A710 Wet Refl Removable Stamark	4in	120yds	120.000	$231.60	1.9300
A710 Wet Refl Removable Stamark	5in	120yds	150.000	$289.50	1.9300
A710 Wet Refl Removable Stamark	6in	40yds	60.000	$115.80	1.9300
A710 Wet Refl Removable Stamark	6in	120yds	180.000	$347.40	1.9300
A710 Wet Refl Removable Stamark	8in	40yds	80.000	$154.40	1.9300
A710 Wet Refl Removable Stamark	48in	20yds	240.000	$463.20	1.9300
A715 Black Removable Stamark	6in	40yds	60.000	$115.80	1.9300
A715 Black Removable Stamark	6in	120yds	180.000	$347.40	1.9300
A715 Black Removable Stamark	8in	40yds	80.000	$154.40	1.9300
A715 Black Removable Stamark	8in	120yds	240.000	$463.20	1.9300
A380AW Wht High Perform All Weather	4in	25yds	25.000	$99.00	3.9600
A380AW Wht High Perform All Weather	4in	70yds	70.000	$277.20	3.9600
A380AW Wht High Perform All Weather	5in	70yds	87.500	$346.50	3.9600
A380AW Wht High Perform All Weather	6in	25yds	37.500	$148.50	3.9600
A380AW Wht High Perform All Weather	6in	70yds	105.000	$415.80	3.9600
A380AW Wht High Perform All Weather	8in	25yds	50.000	$198.00	3.9600
A380AW Wht High Perform All Weather	8in	60yds	120.000	$475.20	3.9600
A380AW Wht High Perform All Weather	10in	25yds	62.500	$247.50	3.9600
A380AW Wht High Perform All Weather	12in	25yds	75.000	$297.00	3.9600
A380AW Wht High Perform All					

Weather	16in	25yds	100.000	$396.00	3.9600
A380AW Wht High Perform All Weather	18in	25yds	112.500	$445.50	3.9600
A380AW Wht High Perform All Weather	24in	25yds	150.000	$594.00	3.9600
A380AW Wht High Perform All Weather	48in	20yds	240.000	$950.40	3.9600
A381AW Ylw High Perf All Weather	4in	25yds	25.000	$99.00	3.9600
A381AW Ylw High Perf All Weather	4in	70yds	70.000	$277.20	3.9600
A381AW Ylw High Perf All Weather	5in	70yds	87.500	$346.50	3.9600
A381AW Ylw High Perf All Weather	6in	25yds	37.500	$148.50	3.9600
A381AW Ylw High Perf All Weather	6in	70yds	105.000	$415.80	3.9600
A381AW Ylw High Perf All Weather	8in	25yds	50.000	$198.00	3.9600
A381AW Ylw High Perf All Weather	10in	25yds	62.500	$247.50	3.9600
A381AW Ylw High Perf All Weather	12in	25yds	75.000	$297.00	3.9600
A381AW Ylw High Perf All Weather	24in	25yds	150.000	$594.00	3.9600
A381AW Ylw High Perf All Weather	48in	20yds	240.000	$950.40	3.9600
L380IES Stamark White Primerless	12in	25yds	75.000	$297.00	3.9600
L380IES Stamark White Primerless	16in	25yds	100.000	$396.00	3.9600
L380IES Stamark White Primerless	24in	25yds	150.000	$594.00	3.9600
L380IES Stamark White Primerless	48in	20yds	240.000	$950.40	3.9600
L381IES Stamark Yellow Primerless	12in	25yds	75.000	$297.00	3.9600
L381IES Stamark Yellow Primerless	16in	25yds	100.000	$396.00	3.9600
L381IES Stamark Yellow Primerless	24in	25yds	150.000	$594.00	3.9600
L381IES Stamark Yellow Primerless	48in	20yds	240.000	$950.40	3.9600
L380AW Wht Linered High Perf All Weather	4in	25yds	25.000	$99.00	3.9600
L380AW Wht Linered High Perf All Weather	5in	25yds	31.250	$123.75	3.9600
L380AW Wht Linered High Perf All Weather	6in	25yds	37.500	$148.50	3.9600
L380AW Wht Linered High Perf All Weather	8in	25yds	50.000	$198.00	3.9600
L380AW Wht Linered High Perf All Weather	10in	25yds	62.500	$247.50	3.9600
L380AW Wht Linered High Perf					

All Weather	12in	25yds	75.000	$297.00	3.9600
L380AW Wht Linered High Perf All Weather	16in	25yds	100.000	$396.00	3.9600
L380AW Wht Linered High Perf All Weather	18in	25yds	112.500	$445.50	3.9600
L380AW Wht Linered High Perf All Weather	24in	25yds	150.000	$594.00	3.9600
L380AW Wht Linered High Perf All Weather	48in	20yds	240.000	$950.40	3.9600
L381AW Ylw Linered High Perf All Weather	4in	25yds	25.000	$99.00	3.9600
L381AW Ylw Linered High Perf All Weather	5in	25yds	31.250	$123.75	3.9600
L381AW Ylw Linered High Perf All Weather	6in	25yds	37.500	$148.50	3.9600
L381AW Ylw Linered High Perf All Weather	8in	25yds	50.000	$198.00	3.9600
L381AW Ylw Linered High Perf All Weather	10in	25yds	62.500	$247.50	3.9600
L381AW Ylw Linered High Perf All Weather	12in	25yds	75.000	$297.00	3.9600
L381AW Ylw Linered High Perf All Weather	16in	25yds	100.000	$396.00	3.9600
L381AW Ylw Linered High Perf All Weather	18in	25yds	112.500	$445.50	3.9600
L381AW Ylw Linered High Perf All Weather	24in	25yds	150.000	$594.00	3.9600
L381AW Ylw Linered High Perf All Weather	48in	20yds	240.000	$950.40	3.9600

Unit Priced Items:

Description	Price Code Description	Price
SMS-L380AW Symbols and Legends	SMS-L380AW-LA Left Curve Arrow 2/Pkg	$342.361
SMS-L380AW Symbols and Legends	SMS-L380AW-ON Only Legend 8' 2/Pkg	$550.38
SMS-L380AW Symbols and Legends	SMS-L380AW-RA Right Curve Arrow 2/Pkg	$341.282
SMS-L380AW Symbols and Legends	SMS-L380AW-SA Straight Arrow 2/Pkg	$234.026
Adhesive and Contact Cement	Stamark Surface Prep Adhesive (1 gal)	$44.183
Adhesive and Contact Cement	Stamark Surface Prep Adhesive (5gal)	$163.458
Stamark SMS-L270ES Legends	SMS-L270ES-LA Left Arrown 4/Pkg	$398.702
Stamark SMS-L270ES Legends	SMS-L270ES-ON Only 2/Pkg	$320.70
Stamark SMS-L270ES Legends	SMS-L270ES-RA Right Arrown 4/Pkg	$398.702
Stamark SMS-L270ES Legends	SMS-270ES-SA Straight Arrow 4/Pkg	$286.03
L380IES STAMARK SYMBOLS AND LEGENDS	SMS-LXXX-LA Left Curve Arrow 4/Pkg	$468.042
L380IES STAMARK SYMBOLS AND LEGENDS	SMS-LXXX-ON Only Legend 2/PKG	$550.38
L380IES STAMARK SYMBOLS AND LEGENDS	SMS-LXXX-RA Right Curve Arrow 4/PKG	$684.337
L380IES STAMARK SYMBOLS AND LEGENDS	SMS-LXXX-SA Straight Arrow 4/Pkg	$684.337

LICENSE PLATE REFLECTIVE SHEETING

Description	SQFT Price	Estimated Five (5) year usage	Estimated Five (5) Year Extended SQFT Price (based on est. usage)	Product Number
5-Year Durability reflective sheeting. Quantity to be made up of any combination of one color, two color, three color, or four color pre-printed designs. Priced as listed below, depending on amount ordered.				
Plain white sheeting	0.82	1,000	$820	4770 (no ensure)
One (1) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	TBD
One (1) Color, Over 41,000 sq. ft.	0.89	5,500,000	$4,895,000	214LT 214VT 214PT
Two (2) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	TBD
Two (2) Color, Over 41,000 sq. ft.	0.97	5,000	$4850	TBD
Three (3) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	TBD
Three (3) Color, Over 41,000 sq. ft.	1.02	5,000	$5,100	TBD
Four (4) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	TBD
Four (4) Color, Over 41,000 sq. ft.	1.08	225,000	$243,000	214BT
5-Year Durability reflective sheeting. Quantity to be made up of any combination of one color, two color, three color, or four color pre-printed designs. Priced as listed below, depending on amount ordered.				
Plain white sheeting	0.82	1,000	$820	4770 (no ensure)
One (1) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	C2107T
One (1) Color, Over 41,000 sq. ft.	0.89	10,500	$9,345	TBD
Two (2) Color, 0 to 41,000 sq. ft.	2.22	1,000	$2,220	TBD
Two (2) Color, Over 41,000 sq. ft.	0.97	250,000	$242,500	TBD

3M Stamark™ High Performance Tape
Series 380I ES

Product Bulletin 380I ES **November 2008**

Replaces 380I ES dated October 2006

Description

3M™ Stamark™ High Performance Tape Series 380I ES can be used as an inlay marking on new asphalt or as an overlay marking on asphalt and concrete pavement surfaces in good condition.

Series 380I ES tape offers "Extended Season" applications due to an improved pressure sensitive adhesive (PSA) package on the bottom surface. Series 380I ES does not require 3M™ Stamark™ Surface Preparation Adhesive P-50 prior to application, if applied during the application season as outlined in the 3M Climate Guide for 3M™ Stamark™ Pavement Marking Tapes.

Series A380I ES: Used for long lines, edge lines, channelizing lines, gore markings, stop bars and crosswalks.

Series L380I ES: Lined. Used to cut symbols and legends.

Series SMS-L380I ES: Lined. Precut symbols and legends.

Properties

A. Product Features

- Durable, conformable to pavement and retroreflective
- Embedded net provides increased tear resistance
- Pressure sensitive adhesive (PSA) on bottom surface
- No surface preparation adhesive required when applied within standard tape application season as defined by the 3M Climate Guide
- Series 380I ES tape can be applied early and late season, down to 40°F (4°C) with use of 3M™ Stamark™ Surface Preparation Adhesive P-50
- Long-term reflectivity design
- Abrasion-resistant microcrystalline ceramic beads bonded in a highly durable polyurethane topcoat
- Yellow microcrystalline ceramic beads incorporated in Series 381I ES tape to improve nighttime yellow color
- Manufactured without the use of heavy metals, lead chromate pigments or other similar, lead-containing chemicals
- Patterned design presents a near vertical surface to traffic to maximize retroreflectance
- Nominal thickness of 0.065 in. (1.6 mm) at pattern heights
- White: 380I ES
- Yellow: 381I ES

B. Reflectance

Series 380I ES tape has the following initial minimum retroreflectance values when measured in accordance with ASTM-D4061. The photometric quality to be measured is coefficient of retroreflected luminance (R_L) and shall be expressed as:

English R_L: millicandelas per square foot per footcandle [(mcd • ft^{-2}) • fc^{-1}] or equivalently as:

Metric R_L: millicandelas per square meter per lux [(mcd • m^{-2}) • lx^{-1}]

	White	Yellow
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
Retroreflected Luminance*	500	300

R_L [(mcd • ft^{-2}) • fc^{-1}]

*The quantity of retroreflected luminance (R_L) "relates to the way the effective retroreflective surface is focused on the retina of the human eye and to the visual effect thereby produced. It is recommended for describing the performance of highway signs and striping, or large vehicular markings which are commonly viewed as discernible surface areas." Federal Test Method Standard 370, 3.1.2, Note 6, March 1, 1977.

C. Color
The preformed markings consist of white or yellow films with pigments selected and blended to conform to standard highway colors.

D. Skid Resistance
The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E 303 except values will be taken in one direction and at 45˚ angle from that direction. These two values will then be averaged to find the skid resistance of the patterned surface.

E. Application
All applications should be installed using the instructions in the appropriate section of 3M Information Folder 380I ES. Surface Preparation Adhesive is not needed when applying the tape during the application season outlined in the 3M Climate Guide for 3M™ Stamark™ Pavement Marking Tapes. The tape can be applied down to 40˚F ambient temperature outside the dates outlined in the Climate Guide for Stamark pavement marking tapes with the use of 3M™ Stamark™ Surface Preparation Adhesive P-50. For long line applications, the P-50 Surface Preparation Adhesive should be applied with a 3M™ Adhesive Spray Applicator PS-14. For transverse markings, the Surface Preparation Adhesive should be applied using a 3/8" nap paint roller.

F. Patchability
Heavy traffic and snow plowing may cause wear and damage. New materials can be installed in these areas with minimal surface preparation by following the manufacturer's recommendations. Remove the damaged material and replace the damaged area by following the instructions in "Overlay Applications" of 3M Information Folder 380I ES.

General Performance Considerations

Stamark pavement marking tapes are weather resistant and provide excellent reflectivity and color retention. Experience has shown that these materials are highly effective traffic control devices and will show no appreciable fading, lifting, shrinkage or chipping when applied according to 3M's recommendations contained in product literature.

The durability of Stamark pavement markings will depend on traffic conditions, snow removal practices, application techniques used, and pavement and atmospheric conditions at the time of application. It is recommended that the customer thoroughly evaluate Stamark tapes under the conditions in the specified location before making large-scale applications.

Warranty

3M warrants that 3M™ Stamark™ High Performance Tape Series 380I ES sold by 3M for longitudinal and symbol and legend pavement marking applications in the United States and Canada will remain effective for its intended use under normal traffic conditions and meet the minimum retained coefficient of retroreflection value of 100 millicandelas per foot squared per foot-candle (measured at 1.05° observation and 88.76° entrance angles) subject to the following provisions:

Table 1

Application*	Warranty Period
Longitudinal markings	4 years
Symbols and legends	2 years

*Applications in mountainous, heavy snowfall areas above 5,000 ft. (1,500m) are not covered by this warranty.

3M also warrants that 3M™ Stamark™ High Performance Tape Series 380I ES sold by 3M for transverse (stopbars and crosswalks) and channelizing marking applications in the United States and Canada will maintain road presence subject to the following provisions:

Table 2

	WARRANTY PERIOD	
	Snow Removal Areas Road presence and non wear-through	Non-Snow Removal Areas Road presence and non wear-through
APPLICATION		
CHANNELIZING MARKINGS		
New Asphalt Inlay	2 years	2 years
Asphalt Grooved/Recessed	2 years	2 years
Asphalt Overlay	1 year	2 years
New Concrete Overlay	1 year	2 years
Concrete Grooved/Recessed	2 years	2 years
STOP BARS, CROSSWALKS WITH ADT/LANE OF 6,000 OR LESS		
New Asphalt Inlay	1 year	2 years
Asphalt Grooved/Recessed	1 year	2 years
Asphalt Overlay	—	1 year
New Concrete Overlay	—	1 year
Concrete Grooved/Recessed	1 year	2 years

If Series 380I ES tape is applied in accordance with all 3M application procedures provided in 3M's product bulletins, information folders and technical memos; and fails to retain the minimum reflectance value (for longitudinal and symbol and legend markings) or fails to adhere to the roadway or fails due to complete wear-through (for transverse and channelizing markings) during the warranty period shown in Table 2 (from the date of installation), 3M's sole responsibility and purchaser's and user's exclusive remedy shall be:

3M will provide the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater.

Conditions

Such failure must be solely the result of design or manufacturing defects in the Stamark high performance tape and not of outside causes such as improper installation or substrate failure. Failure to follow recommended application procedures will void this warranty.

Damage to pavement markings caused by snow removal equipment is not covered under this warranty.

A visual night inspection must be made with a 3M representative and a customer representative present to identify areas of the installation which appear to be below the minimum retained reflectance values specified in Table 1. Areas which appear to be below the minimum retained reflectance value shall be identified as "zones of measurement." To qualify for material replacement, a "zone" must be at least 360 feet in road length and consist of either edge lines, center lines or lane lines, but not in combination, or a single word or symbol marking.

3M reserves the right to determine the type of replacement marking and method of installation.

Replacement markings will carry the unexpired warranty of the marking it replaces.

Claims made under this warranty will be honored only if the customer has maintained an accurate record of the dates of material installation, which constitutes the start of the warranty period.

Claims under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation of Liability

3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MECHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Reflectance Measurement Procedures for Warranty

Step 1: A visual night inspection must be made with a 3M representative and a customer representative present to identify areas of installation which appear to be below the specified minimum retained reflectance values in the Table 1.

Areas which appear to be below the minimum retained reflectance value shall be identified as zones of measurement. To qualify for materials replacement, a zone must be at least 360 feet (108 meters) in road length and shall consist of either edge lines, center lines or lane lines, but not in combination.

Step 2: Within each zone, reflectance measurements must be taken at specified checkpoint areas.

a. Zones Measuring 360 Feet (108 m) to 1,080 Feet (324 m) in Length

No separate checkpoints are required. For continuous lines, reflectance measurements must be made at approximately 20 ft. (6 m) intervals throughout the zone. For skip lines, two measurements must be taken at two random locations on each skip.

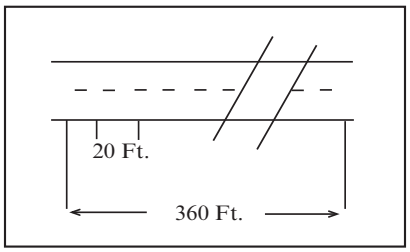

Figure 1

b. Zones Measuring 1,080 Feet (324 m) to 6 Miles (9.6 km) in Road Length

A total of 18 measurements must be made at each of three checkpoints within the zone, including the start point, the mid point and the end point. For continuous lines, reflectance measurements must be made at 20-foot (6 m) intervals throughout each checkpoint. For skip lines, two measurements must be taken at two random locations on each skip.

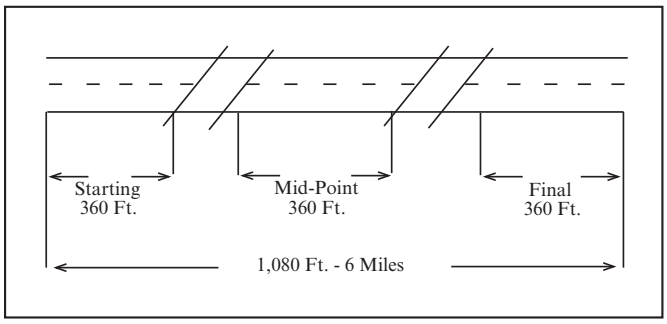

Figure 2: Measure every 20 ft. on continuous lines or 2 measurements per skip for each checkpoint.

c. Zone Greater than 6 Miles in Road Length

A total of 18 measurements must be made in each checkpoint within the zone, including the start point, the end point and at approximately 3-mile (4.8 kilometers) intervals throughout the zone. For measurement intervals on continuous lines, center lines or lane line skips, refer to Section b above.

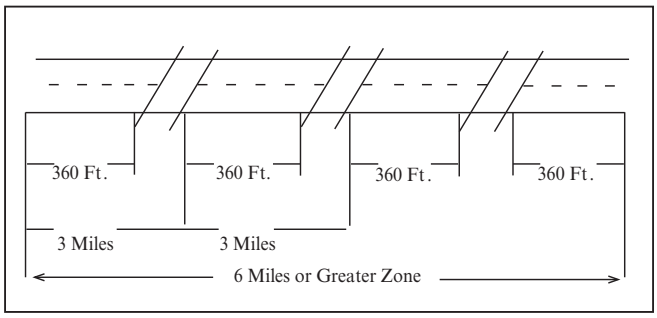

Figure 3: Measure every 20 ft. on continuous lines or 2 measurements per skip for each checkpoint.

Step 3: All reflectance measurements made at the checkpoints shall be made on a clean, dry surface at a minimum temperature of 40˚ F (4˚ C). The test instrument shall use an Entrance Angle of 88.76˚ and an Observation Angle 1.05˚ which represent a simulated driver viewing geometry at a 30 meter distance.

Step 4: All reflectance measurements within the zone must be averaged to determine if the minimum retained reflectance values have been met.

Materials Replacement Condition

Markings must be applied according to the instructions in 3M Information Folder 380I ES to qualify for any applicable materials replacement provisions.

Storage

Store in a cool, dry area indoors. Use within one year of receipt.

Health and Safety Information

Read all health hazard, precautionary and first-aid statements found in the Material Safety Data Sheet (MSDS) and/or product label of chemicals prior to handling or use. Also refer to the MSDS for information about the volatile organic compound (VOC) content of chemical products. Consult local regulations and authorities for possible restrictions on product VOC content and/or VOC emissions. Electronically, visit us at www.3M.com/us and select MSDS search.

Literature Reference

For additional information on Stamark tapes, application instructions or application equipment, refer to the following publications:

IF 380I ES	Application Guidelines for 3M™ Stamark™ High Performance Tape Series 380I ES
IF 5.2	Information Folder for 3M Highway Tape Applicator - HTA
IF 5.7	Pavement Surface Preparation and Application Procedures for Stamark Pavement Marking Tapes
IF 5.8	Application of 3M Stamark Precut Symbols and Legends

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Internet:
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3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Bolger 8110970
Electronic Only

Stamark™ Pavement Marking Tape Series 270 ES

Product Bulletin 270 ES **May 2011**

Description

3M™ Stamark™ Pavement Marking Tape Series 270 ES is a retroreflective patterned polymer pavement marking that can be used as an inlay marking on new asphalt or as an overlay marking on asphalt and concrete pavement surfaces in good condition.

Series 270 ES tape offers "Extended Season" applications due to an improved pressure sensitive adhesive (PSA) package on the bottom surface.

Series 270 ES does not require 3M™ Stamark™ Surface Preparation Adhesive P-50 or 3M™ Stamark™ Low VOC Surface Preparation Adhesive SPA60 prior to application, if applied during the application season as outlined in the 3M Climate Guide for 3M™ Stamark™ Pavement Marking Tapes.

Series A270 ES: Unlinered. Used for long lines, edge lines, channelizing lines, gore markings, stop bars and crosswalks.

Series L270 ES: Linered. Used to cut symbols and legends.

Series SMS-L270 ES: Linered. Precut symbols and legends.

Properties

A. Product Features

- Durable, conformable to pavement and retroreflective
- Embedded net provides increased tear resistance
- Pressure sensitive adhesive (PSA) on bottom surface
- No surface preparation adhesive required when applied within standard tape application season as by the 3M Climate Guide
- Can be applied early and late season, down to 40°F (4°C) with use of 3M™ Stamark™ Surface Preparation Adhesive P-50 or 3M™ Stamark™ Low VOC Surface Preparation Adhesive SPA60
- Retroreflective layer of glass beads bonded in a highly durable polyurethane topcoat
- Manufactured without the use of heavy metals, lead chromate pigments or other similar, lead containing chemicals
- Nominal thickness of 0.065 in. (1.6 mm) at pattern heights
- White: 270 ES
- Yellow: 271 ES

B. Reflectance

Series 270 ES tape has the following initial minimum retroreflectance values when measured in accordance with ASTM-D4061 and ASTM 4505. The photometric quality to be measured is coefficient of retroreflected luminance (R_L) and shall be expressed as:

English R_L: millicandelas per square foot per footcandle [(mcd • ft^{-2}) • fc^{-1}] or equivalently as:

Metric R_L: millicandelas per square meter per lux [(mcd • m^{-2}) • lx^{-1}]

	White	Yellow
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
Retroreflected Luminance*	300	250

R_L [(mcd • ft^{-2}) • fc^{-1}]

*The quantity of retroreflected luminance (R_L) "relates to the way the effective retroreflective surface is focused on the retina of the human eye and to the visual effect thereby produced. It is recommended for describing the performance of highway signs and striping, or large vehicular markings which are commonly viewed as discernible surface areas." Federal Test Method Standard 370, 3.1.2, Note 6, March 1, 1977.

C. Color

The preformed markings consist of white or yellow films with pigments selected and blended to conform to standard highway colors.

D. Skid Resistance

The patterned surface of the retroreflective pliant polymer shall provide an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303 except values will be taken in one direction and at 45° angle from that direction. These two values will then be averaged to find the skid resistance of the patterned surface.

E. Application

All applications should be installed using the instructions in the appropriate section of 3M Information Folder 270 ES. Surface preparation adhesive is not needed when applying the tape during the application season outlined in the 3M Climate Guide for 3M™ Stamark™ Pavement Marking Tapes. The tape can be applied down to 40°F (4°C) ambient temperature outside the dates outlined in the Climate Guide for Stamark pavement marking tapes with the use of 3M™ Stamark™ Surface Preparation Adhesive P-50 or 3M™ Stamark™ Low VOC Surface Preparation Adhesive SPA60. For long line applications, the P-50 or SPA60 surface preparation adhesive should be applied with a 3M™ Adhesive Spray Applicator PS-14. For transverse markings, the surface preparation adhesive should be applied using a solvent resistant 3/8 inch nap paint roller.

Road lanes are typically exposed to different levels of traffic shear exposure. Road lanes that are exposed to a high frequency of high shear turning, especially by trucks and other large vehicles, require use of SPA60 or P50 for application of Stamark pavement marking tapes. The following table summarized the product and surface preparation adhesive application recommendations by shear condition:

Contact 3M Technical Service at 1800-553-1380 for questions.

Shear Level	Product and Adhesive Recommendation
Very High Shear	Stamark Tape Use SPA60
High Shear	Stamark Tape “A” and “L” Series Use SPA60
Pounds per 100 sq ft	Stamark Tape “A” and “L” Series Use P50 or SPA60
Low Shear	Stamark Tape “A” and “L” Series

Within the Climate Guide Recommendations

F. Patchability

Heavy traffic and snow plowing may cause wear and damage. New materials can be installed in these areas with minimal surface preparation by following the manufacturer’s recommendations. Remove the damaged material and replace the damaged area by following the instructions in “Overlay Applications” of 3M Information Folder 270 ES.

General Performance Considerations

Stamark pavement marking tapes are highly effective traffic control devices when properly applied according to 3M recommendations provided in product bulletins and information folders.

The durability of Series 270 ES tape will depend on traffic conditions, snow removal practices, application techniques used, and pavement and atmospheric conditions at the time of application. Damage will be caused by heavy trucks, excessive encroachment (crossover) on high ADT roadways, narrow lane width, unpaved shoulders, snow removal and ice control techniques. It is recommended that the customer thoroughly evaluate Stamark tapes under the conditions in the specified location before making large-scale applications. While experience has shown that, properly applied, these materials are highly effective traffic control devices, 3M makes no generalized performance claims.

Storage

Store in a cool, dry area indoors. Use within one year of receipt.

Health and Safety Information

Read all health hazard, precautionary and first-aid statements found in the Material Safety Data Sheet (MSDS) and/or product label of chemicals prior to handling or use. Also refer to the MSDS for information about the volatile organic compound (VOC) content of chemical products. Consult local regulations and authorities for possible restrictions on product VOC content and/or VOC emissions. Electronically, visit us at www.3M.com/us and select MSDS search.

Literature Reference

For additional information on Stamark tapes, application instructions or application equipment, refer to the following publications:

IF 270 ES	Application Guidelines for 3M™ Stamark™ Tape Series 270 ES
IF 5.2	Information Folder for 3M Highway Tape Applicator - HTA
IF 5.7	Pavement Surface Preparation and Application Procedures for Stamark Pavement Marking Tapes
IF 5.8	Application of 3M Stamark Precut Symbols and Legends
IF 5.17	Instructions for using 3M Stamark Surface Preparation Adhesive P-50 for 3M Stamark Pavement Tapes
IF 5.21	Instructions for using 3M Stamark Low VOC Surface Preparation Adhesive SPA60 for 3M Stamark Pavement Marking Tapes

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Bolger 11050135
Electronic Only

Stamark™
High Performance All Weather Tape
Series 380AW

Product Bulletin 380AW **January 2009**

Description

3M™ Stamark™ High Performance All Weather Tape Series 380AW is a durable pavement marking tape, highly retroreflective under both wet and dry conditions. Stamark Series 380AW tape utilizes specially designed optics to provide wet and dry performance. Stamark Series 380AW tape can be used as an inlay marking on new asphalt or as an overlay marking on most asphalt and concrete pavement surfaces in good condition.

Series A380AW: Used for lane lines, edge lines, channelizing lines and gore markings.

Series L380AW: Lined. Used to cut symbols and legends.

SMS L380AW: Lined. Precut symbols and legends.

Properties

A. Product Features

- High retroreflective performance, wet or dry
- Durable, conformable and retroreflective
- New product design that provides long-term reflectivity
- Abrasion-resistant microcystalline ceramic beads bonded in a highly durable polyurethane topcoat
- Manufactured without the use of heavy metals, lead chromate pigments or other similar, lead-containing chemicals
- Improved patterned surface that presents a near vertical surface to traffic to maximize retroreflectance
- Precoated with an extended season pressure sensitive adhesive (PSA) on bottom surface
- Nominal thickness of 0.080 in. (2 mm) at pattern heights
- White: 380AW
- Yellow microcystalline ceramic beads incorporated in 381AW tape to improve nighttime yellow color
- Yellow: 381AW

B. Reflectance

Stamark Series 380AW has the following initial minimum retroreflectance values under wet and dry conditions. Values are measured under dry conditions in accordance with the testing procedures of ASTM D4061. Retroreflectance values are measured under wet conditions in accordance with ASTM E2176 or ASTM E2177 using a portable reflectometer.

Wet retroreflectance values measured under a “condition of continuous wetting” (simulated rain) will be in accordance with the testing procedure of ASTM E2176. To reduce variability between measurements, test method is to be performed in a controlled laboratory environment while the marking is positioned with a 3 to 5 degree lateral slope. A wetting agent is used to improve wetting of the pavement marking by the water. It is recommended that a 0.1% by volume liquid soap solution be used. Measurements are reported as an average for each roll tested, in a minimum of 3 locations.

Wet reflective values measured under a “condition of wetness” (simulated rain) will be in accordance with the testing procedure of ASTM E2177. The photometric quality to be measured is coefficient of retroreflected luminance (R_L). The test may be performed with the marking installed on the road. New markings are tested using a wetting agent, as previously described. Laboratory measurements are performed using a 3 to 5 degree lateral slope. Measurements are reported as an average for each roll tested, in a minimum of three locations.

Table 1.
380AW Minimum Retroreflectivity Values

White	DRY	WET & RAINY
Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance R_L [(mcd • m^{-2}) • lx^{-1}]	500	250

Table 2.
381AW Minimum Retroreflectivity Values

Yellow	DRY	WET & RAINY
Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance R_L [(mcd • m^{-2}) • lx^{-1}]	300	200

Note: 380AW and 381AW wet retroreflectance values when measured under a "condition of wetness" will be higher than when measured under a "condition of continuous wetting." Stated minimum values shall be met using either test method.

English R_L: Millicandelas per square foot per foot-candle [(mcd • ft^{-2}) • fc^{-1}]

Metric R_L: Millicandelas per square meter per lux [(mcd • m^{-2}) • lx^{-1}]

Note: Entrance Angle 88.76º and Observation Angle 1.05º represent a simulated driver viewing geometry at a 30 meter distance.

C. Color
The preformed markings consist of white and yellow films with pigment selected and blended to conform to standard highway colors.

D. Skid Resistance
The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E303 except values will be taken in one direction and at 45˚ angle from that direction. These two values will then be averaged to find the skid resistance of the patterned surface.

E. Application
All applications should be installed using the instructions in the appropriate section of 3M Information Folder 5.7.

F. Patchability
Heavy traffic and snow plowing may cause wear and damage. New materials can be installed in these areas with minimal surface preparation by following the manufacturer's recommendations. Remove the damaged material and replace the damaged area by following the instructions in "Overlay Applications" of Information Folder 5.7.

General Performance Considerations

Stamark pavement marking tapes are weather resistant and provide excellent reflectivity and color retention. Experience has shown that these materials are highly effective traffic control devices and will show no appreciable fading, lifting, shrinkage or chipping when applied according to 3M's recommendations contained in product literature.

The durability of Stamark pavement markings will depend on traffic conditions, snow removal practices, application techniques used, and pavement and atmospheric conditions at the time of application. It is recommended that the customer thoroughly evaluate Stamark tapes under the conditions in the specified location before making large-scale applications.

Warranty

3M warrants that 3M™ Stamark™ High Performance All Weather Tape Series 380AW sold by 3M for pavement marking applications in the United States and Canada will remain effective for its intended use under normal traffic conditions and meet the minimum retained coefficient of dry retroreflection value of 100 millicandelas per foot squared per foot-candle (in accordance with ASTM E1710), subject to the following provisions:

Table 3. Warranty Periods

APPLICATION*	DRY Retroreflectivity Warranty Period
Longitudinal Markings	4 years
Symbols and Legends	2 years

*Applications in mountainous, heavy snowfall areas above 5,000 ft. (1,500 m) are not covered by this warranty.

If Series 380AW is applied in accordance with all 3M application procedures provided in 3M's product bulletins, information folders and technical memos; and fails to adhere to the roadway or fails due to complete wear-through during the warranty period shown above (from the date of installation), 3M's sole responsibility and purchaser's and user's exclusive remedy shall be:

3M will provide the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater.

Conditions
Such failure must be solely the result of design or manufacturing defects in the Stamark high performance tape and not of outside causes such as improper installation or substrate failure. Failure to follow recommended application procedures will void this warranty.

Damage to pavement markings caused by snow removal equipment is not covered under this warranty.

A visual night inspection must be made with a 3M representative and a customer representative present to identify areas of the installation which appear to be below the minimum retained reflectance values as specified in the Warranty Statement. Areas which appear to be below the minimum retained reflectance value shall be identified as "zones of measurement." To qualify for material replacement, a "zone" must be at least 360 feet in road length and consist of either edge lines, center lines or lane lines, but not in combination, or a single word or symbol marking.

3M reserves the right to determine the type of replacement pavement marking and method of installation.

Replacement markings will carry the unexpired warranty of the marking it replaces.

Claims made under this warranty will be honored only if the customer has maintained an accurate record of the dates of material installation, which constitutes the start of the warranty period.

Claims under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation of Liability
3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Reflectance Measurement Procedures for Warranty

Step 1: A visual night inspection must be made with a 3M representative and a customer representative present to identify areas of installation which appear to be below the specified minimum retained reflectance values in Table 1.

Areas which appear to be below the minimum retained reflectance value shall be identified as zones of measurement. To qualify for materials replacement, a zone must be at least 360 feet (108 meters) in road length and shall consist of either edge lines, center lines or lane lines, but not in combination.

Step 2: Within each zone, reflectance measurements must be taken at specified checkpoint areas.

a. Zones Measuring 360 Feet (108 m) to 1,080 Feet (324 m) in Length

No separate checkpoints are required. For continuous lines, reflectance measurements must be made at approximately 20 ft. (6 m) intervals throughout the zone. For skip lines, two measurements must be taken at two random locations on each skip.

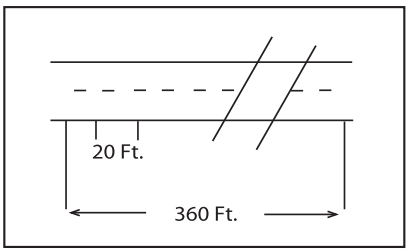

Figure 1

b. Zones Measuring 1,080 Feet (324 m) to 6 Miles (9.6 km) in Road Length

A total of 18 measurements must be made at each of three checkpoints within the zone, including the start point, the mid point and the end point. For continuous lines, reflectance measurements must be made at 20-foot (6 m) intervals throughout each checkpoint. For skip lines, two measurements must be taken at two random locations on each skip.

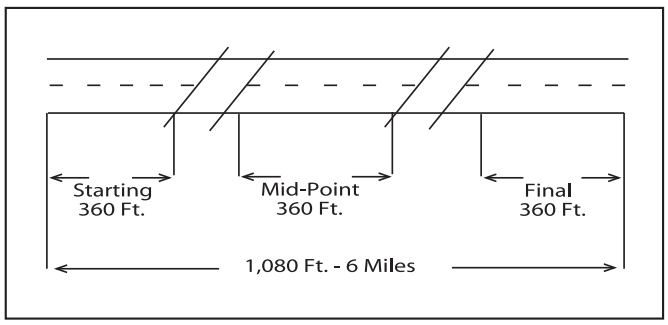

Figure 2: Measure every 20 ft. on continuous lines or (2) measurements per skip for each checkpoint.

c. Zone Greater than 6 Miles in Road Length
A total of 18 measurements must be made in each checkpoint within the zone, including the start point, the end point and at approximately 3-mile (4.8 kilometers) intervals throughout the zone. For measurement intervals on continuous lines, center lines or lane line skips, refer to Section b above.

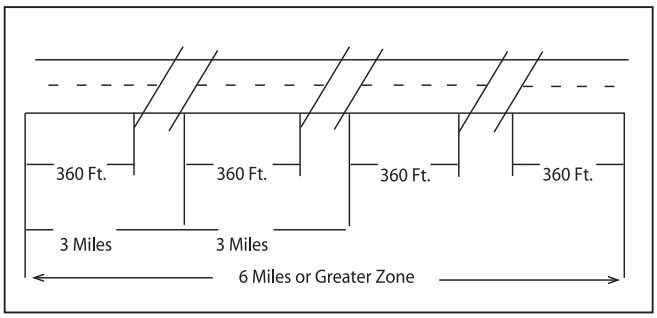

Figure 3: Measure every 20 ft. on continuous lines or (2) measurements per skip for each checkpoint

Step 3: All reflectance measurements made at the checkpoints shall be made on a clean, dry surface at a minimum temperature of 40˚F (4˚C). The test instrument shall use an Entrance Angle of 88.76˚ and an Observation Angle of 1.05˚ which represent a simulated driver viewing geometry at 30 meter distance.

Step 4: All reflectance measurements within the zone must be averaged to determine if the minimum retained reflectance values have been met.

Materials Replacement Condition

Markings must be applied according to the instructions Information Folder 5.7 to qualify for any applicable materials replacement provisions.

Health and Safety Information

Read all health hazard, precautionary and first-aid statements found in the Material Safety Data Sheet (MSDS) and/or product label of chemicals prior to handling or use. Also refer to the MSDS for information about the volatile organic compound (VOC) content of chemical products. Consult local regulations and authorities for possible restrictions on product VOC content and/or VOC emissions. Electronically, visit us at www.3M.com/us and select MSDS search.

Storage

Store in a cool, dry area indoors. Use within one year of receipt.

Literature Reference

For additional information on Stamark tapes, application instructions or application equipment, refer to the following publications:

IF 5.2	Information Folder for 3M™ Highway Tape Applicator - HTA
IF 5.7	Pavement Surface Praeparation and Application Procedures for 3M™ Stamark™ Pavement Marking Tapes
IF 5.8	Application of 3M™ Stamark™ Precut Symbols and Legends

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Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Bolger 8120130
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Stamark™
Wet Reflective Removable Tape
Series 710

Product Bulletin 710 **January 2014**

Replaces PB 710 dated April 2013

Description

3M™ Stamark™ Wet Reflective Removable Tape Series 710 is highly reflective under both wet and dry conditions. Series 710 tape is a conformable marking tape intended for longitudinal line applications in highway work zones where removability is required. The tape is designed to perform for the duration of the normal construction season.[1] After the pavement markings are no longer required, the tape can be manually removed intact or in large pieces.

Series 710 is also supplied as pre-cut symbols and legends for work zone applications. Series 710 tape utilizes specially designed optics to provide dry and wet reflective performance. It is comprised of white or yellow film supported by a flexible, conformable backing. The tape is reinforced by a structured medium and pre-coated with a pressure sensitive adhesive (PSA) for easy, rapid application in temperatures above 50°F (10°C).

[1]A normal construction season is defined as the time after the last snow plowing in the spring and before the first snow plowing in the fall/winter. In locations where snow removal is not performed Series 710 tape is intended for use up to one year. Series 710 tape is a temporary removable product not intended for multi-year applications.

Properties

A. Product Features and Advantages

- Highly reflective, wet or dry.
- Durable during normal work zone season as defined above.
- Skid resistant.
- Coated with pressure sensitive adhesive (PSA).
- Tape available in white and yellow.
- Symbols and legends available in white only.
- Provides continuous delineation, day or night.
- Easy to apply by hand or by machine.
- Easy to remove intact or in large pieces.
- Leaves no lasting marks.
- Roadway may be opened to traffic immediately

Properties (continued)

B. Reflectance

Stamark Series 710 has the following initial minimum retroreflectance values under wet and dry conditions. Values are measured under dry conditions in accordance with the testing procedures of ASTM D4061. Retroreflectance values are measured under wet conditions in accordance with ASTM E2176 or ASTM E2177 using a portable reflectometer.

Wet retroreflectance values measured under a "condition of continuous wetting" (simulated rain) will be in accordance with the testing procedure of ASTM E2176. To reduce variability between measurements, test method is to be performed in a controlled laboratory environment while the marking is positioned with a 3 to 5 degree lateral slope. A wetting agent is used to improve wetting of the pavement marking by the water. It is recommended that a 0.1% by volume liquid soap solution be used. Measurements are reported as an average for each roll tested, in a minimum of three locations.

Wet reflective values measured under a "condition of wetness" (simulated rain) will be in accordance with the testing procedure of ASTM E2177. The photometric quality to be measured is coefficient of retroreflected luminance (R_L). The test may be performed with the marking installed on the road. New markings are tested using a wetting agent, as previously described. Laboratory measurements are performed using a 3 to 5 degree lateral slope. Measurements are reported as an average for each roll tested, in a minimum of three locations.

Table 1 - 710 Minimum Retroreflectivity Values

White	Dry	Wet & Rainy
Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance	500	250
R_L [(mcd • m^{-2}) • lx^{-1}]		

Table 2 - 711 Minimum Retroreflectivity Values

Yellow	Dry	Wet & Rainy
Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance	300	200
R_L [(mcd • m^{-2}) • lx^{-1}]		

Note: 710 wet retroreflectance values when measured under a "condition of wetness" will be higher than when measured under a "condition of continuous wetting." Stated minimum values shall be met using either test method.

English R_L: Millicandelas per square foot per foot-candle [(mcd • ft^{-2}) • fc^{-1}]

Metric R_L: Millicandelas per square meter per lux [(mcd • m^{-2}) • lx^{-1}] Note: Entrance Angle 88.76º and Observation Angle 1.05º represent a simulated driver viewing geometry at a 30 meter distance.

C. Color

The preformed markings consist of white or yellow.

D. Skid Resistance

The surface of the Series 710 tape provides a minimum initial average skid resistance value of 45BPN when tested according to ASTM E 303.

E. Application

All applications of Series 710 tapes should be installed using the instructions in this Product Bulletin and the appropriate section of 3M Information Folder 3.2 and the 3M Road Surface Guide for suitability of application. The newly marked area can be opened to traffic immediately following application.

Surface Preparation Adhesive is not needed when applying the tape under normal conditions as outlined under the General Application Conditions section of this bulletin. Under marginal weather conditions, 3M™ Stamark™ Surface Preparation Adhesive P-50 can be used to improve initial and long term adhesion. For long line applications, the P-50 Surface Preparation Adhesive should be applied with a 3M™ Adhesive Spray Applicator PS-14. For symbols and legends, the Surface Preparation Adhesive should be applied using a 3/8" nap paint roller.

Marginal weather conditions can include circumstances where:

- The air and pavement temperatures will not drop below the minimum application temperature for the next 24 to 48 hours after installation.
- Prolonged or heavy rainfall following tape application is predicted.
- Application is to occur in early spring or late fall beyond typical road construction season.

General Application Conditions:

- Air and pavement temperature minimums for Series 710 tape are 50°F (10°C) and rising.
- Pavement surface must be clean and dry.
- Butt splices must be used. Do not overlap tape ends.
- Do not apply tape on longitudinal seams or joints.
- In areas of high traffic encroachment or on rough, exposed aggregate surfaces, service life may be limited, for example: tined Portland cement or open graded ACC. In this situation it is recommended that the tape be inspected for replacement on a two-month cycle.

F. Removability

The tape is removable from asphalt and smooth Portland cement concrete surfaces intact or in large pieces at temperatures above 32°F (0°C) without the use of heat, solvents, grinding, or sandblasting. Use the following procedure:

1. Wear gloves and use a chisel-like tool to pry up the edge of the tape.
2. Pull straight up at a 90° angle to the pavement.
3. A small amount of heat may be used to help soften the adhesive when removing Stamark tape during cold weather conditions.

Note: Burning or grinding is not recommended. Removal and replacement during the normal construction season as defined in the Description section may be required in areas of high encroachment or on rough exposed aggregate surfaces using mechanical methods such as high pressure water blasting. User is responsible for determining suitability of product.

Storage

Stamark tapes should be stored in a cool, dry indoor area and used within one year of receipt.

Health and Safety Information	Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet (MSDS), and/or product label of chemicals prior to handling or use. When using a pavement preparation adhesive with this product, refer to the appropriate MSDS for information about the volatile organic compound (VOC) content of the adhesive. Consult local regulations and authorities for possible restrictions on product VOC content and/or VOC emissions. Electronically, visit us at www.3M.com/us and select MSDS search.
General Performance Considerations	3M™ Stamark™ Wet Reflective Removable Tape Series 710 is designed to provide excellent reflectivity under both wet and dry conditions. Actual performance will be dependent on pavement and atmospheric conditions at the time of application, application method, traffic and exposure conditions. The user should test for conformance to their requirements before making large scale applications. 3M makes no generalized effective performance claims or material replacement provisions. Abrasion or heavy wear may significantly reduce expected effective performance. Our experience has shown that properly installed Series 710 tape is a highly effective traffic control device.

Literature Reference

Information Folder 3.2	Pavement Surface Preparation and Application Procedures for 3M™ Stamark™ Temporary Pavement Marking Tapes.
Information Folder 5.2	3M™ Highway Tape Applicator (HTA).
Information Folder 5.17	Instructions for Using 3M™ Stamark™ Surface Preparation Adhesive P-50. 3M Road Surface Guide.

FOR INFORMATION OR ASSISTANCE CALL: 1-800-553-1380

IN CANADA CALL: 1-800-265-1840

Internet: www.3M.com/roadwaysafety

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Stamark™

Temporary Removable Black Mask A715

Product Bulletin A715 **January 2011**

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet (MSDS), and/or product label of chemicals prior to handling or use.

Description

3M™ Stamark™ A715 Temporary Removable Black Mask is intended to be used to cover existing road markings in temporary highways works situations where removability is required. It is highly skid resistant and the matte black colour helps minimise glare in sunny or wet conditions. The mask is simple to apply and is designed to perform for the duration of standard highway work zones.[1] Once the markings are no longer needed the tape can be quickly and easily removed intact or in large pieces.

Stamark™ A715 comprises a conformable, profiled black marking which is reinforced by a structured netting and is pre-coated with a pressure sensitive adhesive for easy, rapid application. Stamark A715 uses a special temporary adhesive, and as such to ensure removability of A715, surface preparation adhesive should not be used. The road can be opened to traffic immediately after application.

1. Dependent on application, traffic levels and snow removal practices, A715 is intended for use for up to 1 tape application season.

Product Features

- Durable, conformable, matte black top surface
- Easy to apply by hand or machine
- Road can be opened immediately after application
- Highly Skid Resistant
- Coated with a "Primerless Temporary" pressure sensitive adhesive on bottom surface
- Easy to remove intact or in large pieces
- Leaves no lasting marks or damage to existing road surface

Product Performance

3M™ Stamark™ Temporary Removable Black Mask A715 achieved the following classes of performance assessed to BS 7962 after road trial according to BS EN 1824:

Colour	B (Luminance)	SRT
Black	***0.04***	***58***

General Performance Consideration

Maximum durability of 3M™ Stamark™ Road Marking Tape will be realized when properly applied according to 3M recommendations provided in product bulletins and information folders.

The durability of A715 tape will depend on traffic conditions, application techniques used, as well as road and atmospheric conditions at the time of application. Damage may be caused by heavy trucks, excessive encroachment (crossover), narrow lane width, unpaved shoulders, snow removal and ice control techniques, such as sanding. It is recommended that the customer thoroughly evaluate A715 tape under the conditions in the specified location before making large- scale applications.

While experience has shown that, properly applied, these materials are highly effective traffic control devices; 3M makes no generalized durability claims.

Application

All applications of A715 tape should be installed using the instructions in this Product Bulletin and the appropriate Information Folders.

Only the Overlay method of application is suitable for the 3M™ Stamark™ A715, in order to ensure the product retains its removability characteristics.

Climatic and surface conditions for Overlay applications:

- Air and Surface Temperatures: +10°C and rising
- Relative Air Humidity: < 80 %
- Clean and dry surface, no rain 48 hours prior to the application.
- Do not apply tape on longitudinal road surface joints.

Application Steps:

- Sweep road surface and use a high pressure air blower to remove dust and debris
- Apply tape by hand or using a Tape Applicator. The A715 should be wide enough to cover a marking in a single taped line and should extend beyond each side of the marking by approximately 2.5cm (~1inch)
- The existing MTA-2 application equipment has to be upgraded using the plasmacoated transportation roll kit **DR995032239** in order to prevent adhesive sticking
- Use butt splices where required, do not overlap tape
- Immediately after application tamp the Stamark thoroughly to ensure good adhesion, using a tamper cart (90kg load) or truck tyre. The truck must be equipped with a pointing device to aid the driver in

keeping the tyre on the tape. Tamp in the direction of application. Make 3 slow passes over the tape ensuring the tamper/tyre is not twisted or turned on the tape. Tamping is most important!

- Make sure all edges are firmly adhered
- Application can be made to pre-existing thermoplastic or paint lines that are in good condition e.g not flaking, chalking or otherwise coming away from the road surface. Suitability tests should be conducted prior to large applications

Removability

A715 Black Mask is removable intact or in large pieces at temperatures above +4°C without the use of heat, solvents, grinding or sandblasting. Use the following procedure:

- Wear gloves and use a chisel-like tool to lift up the edge of the tape
- Pull straight up at 90° angle to the road
- At temperatures below +4°C the tape may be more difficult to remove in large pieces. A small amount of heat may be used to soften the adhesive when removing A715 during cold weather conditions

Storage

Store 3M™ Stamark™ Temporary Removable Black Mask A715 in a cool, dry area indoors. Use within one year of receipt.

Literature Reference

For additional information on 3M™ Stamark™ Tapes, Application Instructions or 3M™ Application Equipment, refer to the following publications:

IF OV	Information Folder Overlay Application
IF AP	Information Folder Inlay Application
IF BPlus	Information Folder BitumenPlus Application
IF PS-98	Information Folder Adhesive Spray Applicator PS-98
IF P50	Information Folder Surface Preparation Adhesive 3M™ Stamark™ P50
IF MTA2	Information Folder Manual Tape Applicator MTA-2
IF RTC-3	Information Folder Roller Tamper Cart RTC-3

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3M™ Stamark™ Surface Preparation Adhesive P-50

Instructions for use with 3M™ Stamark™ Pavement Marking Tapes

Information Folder 5.17 **May 2014**

Replaces IF 5.17 dated March 2010

Directions for Use	3M™ Stamark™ Surface Preparation Adhesive P-50 is extremely flammable; handling and storage precautions on the container must be observed. Containers must be opened away from the face slowly and carefully to vent any internal vapor pressure. Stamark surface preparation adhesive P-50 is applied by using the Adhesive Spray Applicator PS-14. Use P-50 within two years of receipt. See Storage Recommendations for proper methods of storage.
Coverage	P-50 sprayable adhesive coverage is about 450 lineal ft/gal. (35 m/l) spraying a 6-inch (15 cm) wide pattern. The resulting wet thickness is approximately 6.0–7.0 mil. If tape wider than six inches (15 cm) is to be applied, make multiple passes with the adhesive spray applicator.
Application Conditions — Stamark™ Durable Tapes	1. Air temperature — Minimum 40°F (4°C) and rising in a season when nighttime lows are above 40°F (4°C). To determine if P-50 is required, refer to the 3M Climate Guide or product bulletin for tape to be applied. 2. No rainfall for previous 24 hours. Other visible signs of moisture (dew or frost) should not be present. 3. Asphalt surfaces must be at least three days old before applying the P-50 adhesive. 4. Concrete surfaces open to traffic less than 90 days must have the curing compound removed before applying P-50. Curing compound can be removed by sandblasting or other methods such as shotblasting or hydroblasting. If hydroblasting is used the road must be allowed to dry completely before application of P-50 and Stamark tapes. 5. The pavement surface must be clean, dry, and in good condition. 6. Do not apply P-50 over old pavement markings such as paint, epoxy, thermoplastic, and preformed tapes including Stamark tapes. Old pavement markings must be removed using methods such as sandblasting, shotblasting, or grinding. Hydroblasting may also be used, but the road must be allowed to dry for a minimum of 24 hours before application of P-50 and Stamark tapes. At least 90 percent of the old pavement marking material must be completely removed down to the road surface prior to application of P-50. 7. Traffic must be kept off of pavement surfaces coated with a surface preparation adhesive prior to tape application.

Application Conditions — Stamark™ Temporary Removable Tapes	For application of P-50 with Stamark Temporary Removable Tapes, refer to Information Folder 3.2. For additional information on the application of P-50 for Series 710 under marginal weather conditions or on a poor surface, contact 3M Pavement Markings Technical Service at 1-800-553-1380.
Application Procedures	1. Completely clean and flush the spray equipment with Acetone or Methyl Ethyl Ketone before spraying P-50. 2. Clean the pavement surface thoroughly and mark the position where the pavement marking will be applied. 3. Apply one coat of P-50 sprayable adhesive. Spray the adhesive a minimum of one (1) inch (2.5cm) beyond where the edges of the tape will be applied. 4. Allow the P-50 to set. P-50 is set when it feels tacky but is no longer in liquid form and has a matte finish rather than a glossy wet appearance. P-50 dries quickly under most circumstances. Typical time for P-50 to set is two to three (2 – 3) minutes under optimal conditions of 70°F (21°C) and medium to low humidity levels. Use methods described Information Folder 5.7 to verify that P-50 is set. 5. After P-50 is set, apply the tape by using methods described in Information Folder 5.7. Do not allow P-50 to remain on the road without tape application for an extended time. A delay will result in dirt and dust forming a film on the P-50 surface reducing adhesion performance. 6. Tamp the tape thoroughly with the 3M™ Roller Tamper Cart (RTC-2) with a minimum 200 lb (90 kg) load or slowly drive over the tape making six passes over each part of the tape. The vehicle should be equipped with a pointing device to aid in keeping the vehicle on the tape. **Tamping is very important!** **RTC-2 Operating Instructions** • Do not twist or turn the tamping device on tape. • Make six passes over each part of the tape. • Make sure all edges are firmly adhered. • Open to traffic as soon as tamping is complete.
Clean-Up	1. When finished applying surface preparation adhesive, pull the PS-14 applicator backwards eight to ten (8-10) feet to draw the adhesive back into the can, and remove the siphon tube from the adhesive. 2. Insert the siphon tube into a can of Acetone or Methyl Ethyl Ketone. Place a catch pan under the spray nozzle and rotate the front wheel until the solvent from the spray nozzle appears clear. 3. Rotate the pump backwards to draw the solvent back into the can. 4. Dispose of the cleaning solvent according to local regulations and guidelines.
Recommended Storage	Store away from heat in a cool, dry place and protect from freezing. Store out of direct sunlight. Keep container closed when not in use. Keep container in well ventilated area. Contents may be under pressure; open carefully.
Health and Safety Information	Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet (MSDS), and/or product label of chemicals prior to handling or use. Also refer to the MSDS for information about the volatile organic compound (VOC) content of chemical products. Consult local regulations and authorities for possible restrictions on product VOC content and/or VOC emissions.

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3M
Diamond Grade™ Conspicuity Markings

Series 983

Product Bulletin 983 **June 2004**

Description

3M™ Diamond Grade™ Conspicuity Markings Series 983 are highly retroreflective micro-prismatic markings designed to mark the sides and rear of vehicles for enhanced visibility and detection. The reflective marking consists of prismatic lenses that are formed in a transparent, synthetic resin, sealed and backed with a pressure-sensitive adhesive and clear poly liner. Applied to properly prepared surfaces Diamond Grade markings should provide seven years of field performance.

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

Series 983-10, 983-32, 983-326 and 983-72 meet or exceed all FMVSS 108 requirements, including DOT-C2 Certification Mark.

- 1, 1.5, 2, 3 and 4 inch wide x 50 yard rolls
- High brightness
- Wide angularity to almost 90˚ from perpendicular

Easy to apply

- Aggressive pressure sensitive adhesive
- Easy to remove liner
- Available in convenient rolls, packaged pieces, or kiss-cut pieces on a roll

Durable

- Pre-sealed edges
- Non-metallic construction to prevent corrosion
- 7 year warranty (non-prorated)

Product Code	Color	Size	DOT Mark
983-10	White	2, 3, 4 inch x 50 yards (Edge Sealed)	Yes
983-32	Red 11 inch/White 7 inch, (Alternating Pattern)	1-1/2, 2, 3, 4 inch x 50 yard (Edge Sealed)	Yes
983-326	Red 6 inch/White 6 inch (Alternating Pattern)	1, 1-1/2, 2 inch x 50 yards (Edge Sealed)	Yes
983-71	Yellow	1, 1-3/4, 2 inch x 50 yards (Edge Sealed)	No
983-72	Red	2, 3, 4 inch x 50 yards (Edge Sealed)	Yes

Coefficient of Retroreflection

Measurements are made in accordance with ASTM E-810 "Standard Test Method for Coefficient of Retroreflective Sheeting" in terms of candlepower per foot-candle per square foot (cd/lux/m^2).

Table A. Typical Coefficient of Retroreflection (R_A) for New Sheeting (cd/lux/m^2).

	Observation Angle[1]					
	0.2°			0.5°		
Entrance Angle[2]	**-4°**	**30°**	**45°**	**-4°**	**30°**	**45°**
983 Typical Values White	800	550	345	460	215	85
(FMVSS 108 Requirement)	(250)	(250)	(60)	(65)	(65)	(15)
983 Typical Values Red	160	110	60	95	40	16
(FMVSS 108 Requirement)	(60)	(60)	(15)	(10)	(10)	(4)
983 Typical Values Yellow	645	420	235	360	180	65

[1]Observation Angle - the angle formed by the light beam striking the reflective surface and the light beam returning to the observer (from 800 feet, a motorist normally views a marking at approximately an 0.2° observation angle).

[2]Entrance Angle - the angle formed by a light beam striking a surface at a point and a line perpendicular to the surface at the same point.

Typical Physical Properties

The following technical information should be considered typical only and should not be used for specification purposes.

Property	FMVSS 108 Requirement	Series 983 Typical Value	
Thickness (Caliper)	No requirement	0.014 inch - 0.018 inch	
Whiteness			
Reflective Limit Y	> 15 White	45 White	
ASTM E1164	> 2.5 Red	5 Red	
Gloss	No requirement	100	
ASTM D523 @ 85°			
Dimensional Stability	< 1/8 inch change on	No measurable change	
ASTM D4956	9 x 9 inch panel		
Flexibility - wrap around	No cracking	No cracking	
0.125 inch mandrel @ 32°F (0°C)			
High pressure wash test	No requirement	Passes	
45° angle, 1200 psi, 8 inch away			
Adhesion			
90° Hanging Weight	< 2 inch (55mm) movement	0.2 inch (4 mm)	
ASTM D4956			
Minimum Application Temp.		60°F (15°C)	
Instron Peel Adhesion			
12 inch/minute, 90° pullback	No requirement	Degreased aluminum	5.3 lb/in (.95 kg/cm)
		Prepainted panel	3.0 lb/in (0.55 kg/cm)
		Stainless steel	6.0 lb/in (1.1 kg/cm)
		FRP	2.5 lb/in (0.52 kg/cm)
		Tedlar™	3.0 lb/in (0.54 kg/cm)
		Aluminum Rail	3.5 lb/in (0.56 kg/cm)

Property	FMVSS 108 Requirement	Series 983 Typical Value
Chemical Resistance SAE J1967	No requirement	Not affected by toluene, #2 diesel fuel, gasoline (leaded) kerosene, TSP detergent, xylene, dilute metal brighteners
Corrosion Resistance ASTM B-117 Salt Spray	No requirement	No effect 1000 Hours
Impact Resistance		
Room Temperature 100 in-lb, 5/8 inch tip	No damage outside impact	No damage outside impact
Cold temperature 60 in-lbs at -20˚F	No requirement	No damage outside impact

Maintenance

Cleaning

Routine washing is recommended for maximum performance. The following cleaning methods are recommended.

- Wash with sponge, cloth or soft brush using water and detergent.
- Automatic truck/car wash or standard high-pressure hand spray:

  Maximum pressure-1200 PSI/ 80 bar.

  Maximum water/wash solution temperature-140˚F/ 60˚C.

  Minimum of 12 inches/ 30cm distance of cleaning jet(s) from markings.

  Cleaning wand or jets to be at **no greater** angle than 45 degrees from perpendicular to the marking surface.
- When using metal brighteners, follow manufacturer's recommendations for dilution. Thoroughly rinse from markings after soaking vehicle.

Storage

- Cool, dry area out of direct sunlight.
- Temperature 65-75˚F (18-24˚C) humidity 30-50%.
- Store rolls horizontally, in carton or in original packaging.

Shelf Life

- Apply series 983 markings within two years of receipt of material.

General Performance Considerations

Series 983 markings will provide maximum durability when:

- 3M recommended procedures are followed.
- Marking is applied to vertical surfaces.

Actual durability will be based on actual customer use, field testing, exterior exposed testing and artificial weathering testing.

Durability can be reduced if recommended techniques are not followed:

- Failure to cut markings around rivets, seams and body are panels.
- Improper use of high pressure cleaning.
- Spillage of chemicals or solvents.
- Improper application or surface preparation.

Warranty

3M warrants that 3M™ Diamond Grade™ Conspicuity Markings Series 983 sold by 3M to be used for truck and trailer conspicuity markings in the United States and Canada will remain effective for its intended use and meet the stated minimum values for coefficient of retroreflection for seven years, subject to the following provisions:

Marking Color	Minimum Coefficient of Retroreflection Candelas per foot candle per Sq. Ft. Candelas per Lux per Square Meter (.2˚ Observation and -4˚ Entrance)[3] (FMVSS 108 Requirement)
White	250
Red	60

[3]All measurements shall be made after cleaning according to 3M recommendations and in accordance with ASTM E 810 "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting."

If Diamond Grade conspicuity marking is processed and applied to a vertical ±20˚ surface in accordance with all 3M application and fabrication procedures provided in 3M's product bulletins, information folders, technical memos (which will be furnished to the agency upon

request), including the exclusive use of 3M process colors and clear coatings, and recommended application equipment; and

If the marking deteriorates due to natural causes; such as fading, cracking, peeling, lifting, discoloration or the coefficient of retroreflection is less than the minimum herein specified; 3M's sole responsibility and purchaser's and user's exclusive remedy shall be that 3M will provide full replacement of the 3M materials for seven years from the date of installation.

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M™ Diamond Grade™ Conspicuity Markings and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of process colors, thinners, or coatings not made by 3M; use of application procedures not recommended by 3M; applied to a surface at greater than $\pm 20^{\circ}$ from vertical; failure of substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the marking; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement.

Replacement markings will carry the unexpired warranty of the marking it replaces.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation and Liability

3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Literature Reference

IF 4.9 Application Instructions for Diamond Grade Conspicuity Markings Series 983

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3M Diamond Grade™ VIP Reflective Sheeting

Visual Impact Performance (VIP)
Series 3990

Product Bulletin 3990 **August 2005**

Replaces PB 3990 dated May 2004

Description

3M™ Diamond Grade™ VIP Reflective Sheeting is a wide angle prismatic lens reflective sheeting designed for the production of durable traffic control signs and delineators that are exposed vertically in service. This sheeting is designed to provide higher sign brightness than sheetings that use glass bead lenses. It is intended to also provide high sign brightness in the legibility distance where other sheetings do not. This feature is shown by the values at 1.0˚ observation angle in Table B which represents these viewing geometries. VIP sheeting also provides brightness at high entrance angles shown by the values at 40˚ in Table B. Applied to properly prepared sign backings, VIP sheeting will provide long term service.

Color	Product Code
White	3990
Yellow	3991
Red	3992
Blue	3995
Green	3997

Photometrics

Daytime Color (x,y,Y)
The chromaticity coordinates and total luminance factor of the retroreflective sheeting conform to Table A.

Color Test
Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E-1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 spectrocolorimeter with option CMR 559 or equivalent. Computations shall be done in accordance with E-308 for the 2˚ observer.

Coefficients of Retroreflection (R_A)
The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per square meter ($cd/lux/m^2$).

Test for Coefficients of Retroreflection
Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 “Test Method for Coefficient of Retroreflection of

Table A - Color Specification Limits* and Reference Standards

									Daytime Luminance Limit (Y%)	
Color	x	y	x	y	x	y	x	y	Min.	Max.
White	.305	.305	.355	.355	.335	.375	.285	.325	40	-
Yellow	.487	.423	.545	.454	.465	.534	.427	.483	24	45
Red	.690	.310	.595	.315	.569	.341	.655	.345	3	15
Blue	.078	.171	.150	.220	.210	.160	.137	.038	1	10
Green	.030	.398	.166	.364	.286	.446	.201	.794	3	9

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illumination Source D65.

Retroreflective Sheeting" and per E-810 the values of 0˚ and 90˚ rotation are averaged to determine the R_A in Table B.

Table B - Minimum Coefficient of Retroreflection R_A for new sheeting (cd/lux/m2)

-4˚ Entrance Angle[2]

	Observation Angle[1]		
	0.2˚	**0.5˚**	**1.0˚**
White	380	275	80
Yellow	300	220	60
Red	98	70	20
Green	45	32	9.0
Blue	22	17	4.5

30˚ Entrance Angle[2]

	Observation Angle[1]		
	0.2˚	**0.5˚**	**1.0˚**
White	225	135	45
Yellow	180	100	35
Red	65	32	11
Green	28	16	6.0
Blue	14	8.0	3.0

40˚ Entrance Angle[2]

	Observation Angle[1]		
	0.2˚	**0.5˚**	**1.0˚**
White	90	35	10
Yellow	70	27	8.8
Red	26	10	3.0
Green	9.8	3.5	1.6
Blue	4.5	1.5	0.8

[1]Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[2]Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Screenprinted Colors and Overlay Films

For screenprinted transparent color areas on white sheeting, or white sheeting covered with 3M™ ElectroCut™ Film Series 1170 when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 70% the value for corresponding color in Table B.

Orientation

3M™ Diamond Grade™ VIP Reflective Sheeting is designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or ultimate orientation after installation. However, because the efficiency of light return from cube corner reflectors is not equal at all rotation angles, it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular way.

When extra wide entrance angle performance is important for a given sign type or situation, you may elect to make the signs with a specific orientation. However, unless the location and/or position calls for extra-wide entrance angularity performance signs can be manufactured and installed using the orientation that most efficiently utilizes the reflective sheeting.

For purposes of test measurement of the sheeting, it is important for the material to have a datum mark (the orientation arrows) so that the sample can be properly oriented in the test machinery. In those situations where extra wide entrance angle performance is required, this arrow can be used to assure the preferred orientation.

NOTE: In cases where letters and numbers are placed on the same sign, it is recommended they be placed with identical orientation.

Interlocking Diamond Seal Pattern

This pattern is unique to 3M wide angle prismatic retroreflective sheetings.

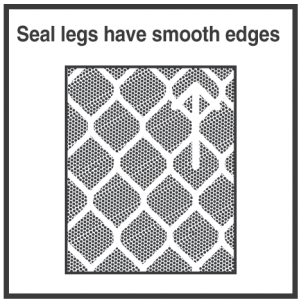

Figure 1 - Sheeting is positioned at a 0° angle.

Datum Marks (Arrows)

Series 3990 sheeting is made with small arrows in the surface repeated three times across a 36 inch roll and at 12 inch intervals (Figure 2) down the roll. These arrows which point down the length of the roll serve as reference marks for photometric testing. The arrows are also used as visual aids to sheeting orientation when fabricating signs for special high entrance angle situations. The arrow differentiates VIP sheeting from other Diamond Grade sheetings.

Tooling Lines

The manufacturing of a prismatic sheeting results in tooling lines being present in the product. In 3M™ Diamond Grade™ VIP Reflective Sheeting, these lines are slightly thicker than the seal pattern legs. Tooling lines are noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 2).

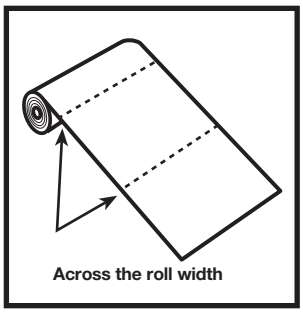

Figure 2 - Tooling Lines

Adhesive

Series 3990 sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 65˚F (18˚C) or higher.

Test Methods of Adhesive and Film

Standard Test Panels

Unless otherwise specified herein, sheeting shall be applied to test panels in accordance with ASTM D4956 - 01, section 7.2 and test conditions shall conform to ASTM D4956 section 7.1.

Properties

Standard Conditioning - all mounted and unmounted test specimens shall be conditioned for 24 hours at 73˚F ± 2˚F (23˚C ± 1˚C) and 50% ± 4% relative humidity before testing.

1. Adhesive

The retroreflective sheeting shall comply with the liner removal and adhesion requirements contained in ASTM D4956 sections 7.10 and 7.5 respectively.

2. Impact Resistance

Test Method - Apply sheeting to a standard panel 3 x 6 inch (7.6x15.2cm) and condition. Subject sheeting to a 50 inch pounds (5.7Nm) impact in accordance with ASTM D-2794.

Requirement - No separation from panel or cracking outside immediate impact area.

3. Shrinkage

The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D4956 sections 7.10 and 7.5 respectively.

4. Flexibility

Test Method - Following conditioning of 1 x 6 inch sample, remove liner and dust adhesive with talc. At standard conditions, bend in one second around 1/8 inch (3.2mm) mandrel with adhesive side facing mandrel.

Requirement - No cracking, peeling or delamination.

5. Gloss

Test Method - Test in accordance with ASTM D523 using an 85˚ glossmeter.

Requirement - Rating not less than 40.

Sign Fabrication Methods

Application

Diamond Grade VIP sheeting series 3990 incorporates a pressure-sensitive adhesive and should be applied to the sign substrate at room temperature (65˚F/18˚C) or higher by any of the following methods:

Mechanical squeeze roll applicator - IF 1.4[3]

Application to extrusions require heat directed at the next-to-last edge roller. Cracking may occur if the top film is not sufficiently softened.

Hand squeeze roll applicator - IF 1.6

[3]Note - never direct the Calrod™ heater at the sheeting during application. If the heater is needed to warm to the minimum application temperature of 65˚F, direct it at the substrate only.

Hand Application

Hand application is recommended for legend and copy only. Application of Diamond Grade sheeting for complete signs or backgrounds must be done with a roll laminator, either mechanical or hand. See Information Folder 1.5 for more details.

Hand applications will show some visual irregularities which are objectionable to aesthetically critical customers. These are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.

All direct applied copy and border MUST be cut at all metal joints and squeegeed at the joint.

Splices

Series 3990 sheeting should be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other at the splice and a gap of up to 1/16 inch is acceptable. This is to prevent buckling as the sheeting expands in extreme temperature and humidity exposure.

If the visual appearance of the splice is important or a slight gap is undesirable, the following procedures must be followed:

1. Overlap the sheeting at least one inch, with or without the liner attached.
2. Using a straight edge and a sharp utility knife, cut through both layers of reflective sheeting.
3. Peel back and remove cut remnants. If liner was left on, remove and roll down remaining sheeting.
4. Seal edge with thinned 3M™ 880I Process Color Clear using a fine artist paint brush.

Double Faced Signs - Series 3990 sheeting on the first side must be protected from damage from the steel bottom roll of squeeze roll applicators with FR-2 sponge rubber and SCW 568.

Substrates

For traffic sign use, product application is limited to properly prepared aluminum (see Information Folder 1.7). Extrusions are to be wrapped, and flat panel signs are to be carefully trimmed so that sheeting from adjacent panels do not touch on the assembled signs. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. 3M™ Diamond Grade™ VIP Reflective Sheeting is designed primarily for application to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is essential. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Screen Processing

Series 3990 sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I (see Product Bulletin 880I). Series 880 process colors can be screen processed at 60-100˚F (16-38˚C) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. See Information Folder 1.8 for details. Use of other process colors series is not recommended.

3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or 3M process colors other than those listed above.

Care should be taken to avoid flexing Series 3990 sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.

Cutting and Matching

The sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Series 3990 sheeting can be hand cut from either side with a razor blade or other sharp hand tool. Like all reflective sheetings, when two or more pieces are used side by side on a sign, they must be matched to assure uniform day color and night appearance.

Cutting equipment such as guillotines and metal shears which have pressure plates on the sheeting when cutting may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting Series 3990 sheeting is 1-1/2 inch or 50 sheets. Details on cutting can be found in Information Folder 1.10. Edge sealing VIP sheeting is generally not required. Following extended exposure, airborne dust particles may become trapped within the row of cut cells along the sheeting edge. This should have no adverse effect on sign performance. If the user chooses to edge seal, series 880I toner should be used.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

General Performance Considerations

The durability of Diamond Grade VIP Reflective Sheeting Series 3990 will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

Maximum durability of Series 3990 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in Information Folder 1.7 on Sign Substrate Surface Preparation.

The user must determine the suitability of any nonmetallic sign backing for its intended use. Applications to unprimed, excessively rough or non-weather-resistant surfaces, or exposure to severe or unusual conditions can shorten the performance of such applications.

Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability.

3M process colors, when used according to 3M recommendations, are generally expected to provide performance comparable to colored reflective sheeting, except for certain lighter colors, such as yellow, gold, or heavily toned colors or blends containing yellow or gold, whose durability depends on how much of each color is used. Dilution of color and atmospheric conditions in certain geographic areas may result in reduced durability.

3M™ Scotchcal™ Film 3655 Black, Scotchcal™ film 7720-12, 3M™ Controltac™ Film 180-12 Black, and 3M™ ElectroCut™ Film Series 1170 can be expected to perform satisfactorily for the life of the sign when direct applied to series 3990 sheeting, except where shortened durability is stated in the literature.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. See Information Folder 1.10.

Storage and Packaging

3M™ Diamond Grade™ VIP Reflective Sheeting should be stored in a cool, dry area, preferably at 65-75˚F (18-24˚C) and 30-50% relative humidity and should be applied within one year of purchase.

Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheeting against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face. Packages of finished sign faces must include sufficient nylon washers for mounting.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. See Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are recommended between the heads of all twist fasteners (such as screw heads, bolts, or nuts) and the sheeting to protect the sheeting from the twisting action of the bolt heads.

Warranty

3M warrants that 3M™ Diamond Grade™ VIP Reflective Sheeting to be sold by 3M to be used as components for traffic control and guidance signs in the United States and Canada will remain effective for its intended use and meet the stated minimum values for coefficient of retroreflection for twelve years, subject to the following provisions in Table C.

Table C – Percentage of Table B Initial R_A Minimums Guaranteed Over 12 Year Warranty Period (Colors: white, yellow, red, green and blue)

Warranty Period	Minimum Percentage R_A Retained
1-7 Years	80%
8-12 Years	70%

- R_A percentage retained above apply to all entrance and observation angles presented in Table B, and shall be measured per ASTM E 810.

- All measurements shall be made after cleaning according to 3M recommendations.

If a 3M Diamond Grade VIP sign surface is processed and applied to sign blank materials in accordance with all 3M application and fabrication procedures provided in 3M's product bulletins, information folders, and technical memos (that will be furnished to the agency upon request), including the exclusive use of 3M matched component systems, process colors, clear coatings, electronic cuttable films, protective overlay films, and recommended applications equipment; and

If the sign deteriorates due to natural causes to the extent that: 1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision, or 2) the coefficient of retroreflection after cleaning is less than the minimums specified in Table C, 3M's sole responsibility and purchaser's and user's exclusive remedy shall be:

If the failure occurs within the first 7 years from the date of fabrication, 3M will, at its expense, restore the sign surface to its original effectiveness.

If the failure occurs within the 8th through the 12th year from the date of fabrication, 3M will furnish the necessary amount of 3M Diamond Grade VIP sheeting to restore the sign surface to its original effectiveness.

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M™ Diamond Grade™ VIP Reflective Sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of process colors, thinners, coatings, or overlay films and sheetings not made by 3M; use of application equipment not recommeded by 3M; failure of sign substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the sign; sign burial; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement.

Replacement sheeting will carry the unexpired warranty of the sheeting it replaces.

Claims made under this warranty will be honored only if the signs have been dated at the time of sheeting application, which constitutes the start of the warranty period.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation of Liability and Remedies

3M's liability under this warranty is limited to replacement or allowance as stated herein, and 3M assumes no liability for incidental or consequential damages such as lost profits, business or revenue in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Literature Reference

IF 1.3	Instructions for Squeeze Roll Applicator
IF 1.5	Hand Application Instructions
IF 1.6	Instructions for Hand Squeeze Roll Applicator
IF 1.7	Sign Base Materials
IF 1.8	Color Application Instructions
IF 1.10	Cutting, Matching, Premasking, and Prespacing Instructions
IF 1.11	Storage Maintenance, and Removal Instructions
PB 880I	3M™ Process Color

ASTM Test Methods are available from ASTM International, West Conshohoken, PA

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Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith.

Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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3M Diamond Grade™ DG³ Barricade Sheeting

Series 444/446 Orange and White Prestriped Sheeting For Use on Barricades

Product Bulletin 444/446 **April 2011**

Replaces PB DG6 dated July 2007

Description

3M™ Diamond Grade™ DG³ Barricade Sheeting Series 444/446 is prestriped orange and white (OW) sheeting intended for reflectorizing work zone traffic control barricades. Series 444/446 OW sheeting is designed for use on aluminum or wood substrates as detailed in Information Folder 1.7.

Although series 444/446 OW sheetings have worked well on some flat plastic substrates, the variability of plastics precludes making any general recommendations regarding application to them. Users must assess for themselves the suitability of 444/446 OW series sheetings on plastic substrates.

Diamond Grade sheeting series 444/446 OW consists of impact resistant prismatic lens reflective sheetings precoated with aggressive pressure sensitive adhesive and available in the following prestriped configurations:

Table I - Barricade Sheeting Configuration

	Orange/White
6" left stripe	446-6L OW
6" right stripe	446-6R OW
4" left stripe	444-4L OW
4" right stripe	444-4R OW

Note: "Left" sheetings have stripes that slope from upper left to lower right and are placed on the right to move traffic to the left. Right sheetings are the opposite.

Photometric - Coefficients of Retroreflection

The values in Table II are minimum coefficients of retroreflection expressed in candelas per foot candle per square foot (candelas per lux per square meter).

Table II

Minimum Coefficient of Retroreflection R_A Candelas per Foot Candle per Square Foot or Candelas per Lux per Square Meter (Average 0° and 90° Rotation)

Observation[1] Angle	Entrance[2] Angle	White	Orange
0.2	-4	570	300
0.2	+30	210	120
0.2	+45	65	35
0.5	-4	400	80
0.5	+30	150	75
0.5	+45	30	18

[1]Observation Angle - The angle between the illumination axis and the observation axis.

[2]Entrance Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Measurements are made in accordance with ASTM E810 "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting". The observation angles shall be 0.2° and 0.5°, the entrance angle (B_1) shall be -4°, +30°, and +45°, and the entrance angle (B_2) = 0°. All measurements shall be made after cleaning according to 3M recommendations.

Table III Color Specification Limits ** (Daytime)										
Color	1		2		3		4		Reflectance Limit (Y) (%)	
	x	y	x	y	x	y	x	y	Min.	Max.
White	.303	.300	.368	.366	.340	.393	.274	.329	40	
Orange	.558	.352	.636	.364	.570	.427	.506	.404	7	27

** The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

Color

Colors of the sheeting applied to aluminum test panels shall conform to the requirements of Table III when measured in accordance with ASTM E 1164. The values shall be determined on a Hunter Color Flex Model 45/0 spectrocolorimeter with option CMR 559 or equivalent. Computations shall be done in accordance with ASTM E308 for the 2˚ observer.

Recommended Application Procedures

Series 444/446 OW sheetings may be applied to barricade panels using a squeeze roll applicator or by hand.

The application temperature (and substrate temperature) should exceed 60°F. If hand applied, sheeting should be applied with firm pressure using a plastic squeegee or rubber roller.

3M recognizes that some customers will choose to apply 444/446 OW series sheetings to plastic substrates. Without endorsement of the use of such substrates, some comments regarding their use can be made.

Plastics, including fiberglass laminates, vary as to type, composition, and manufacture, so that their use as an application surface requires careful evaluation under actual use conditions. Some plastics embrittle on exposure and some plastics contain migrating constituents that may contaminate the adhesive or cause sheeting discoloration and adversely affect performance. Also, some plastics are affected by ingredients in the sheeting adhesives that migrate into the panel. Sheeting must NOT be applied to transparent or translucent materials as light transmission may adversely affect adhesion.

Information Folder 1.7 may provide further insight into applications on plastic substrates.

Note: Care must be taken to avoid stretching series 444/446 OW sheetings during application.

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

General Performance Considerations

The durability of Series 444/446 OW barricade sheeting will depend upon many factors including, but not limited to, substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

The user must determine the suitability of this material on any specific substrate (plastic, metal, or wood) for its intended use. Maximum durability can be obtained by following the recommendations contained in Information Folder 1.7 on Sign Base Surface Preparation. Applications on unprimed, excessively rough or non-weather-resistant surfaces, some plastics, or exposure to severe or unusual conditions can reduce the durability of such applications.

Warranty

3M warrants that Diamond Grade™ DG³ Barricade Sheeting Series 444/446 OW sold by 3M to be used as components for traffic control devices will remain effective for its intended use for three years, subject to the following provisions:

If a Diamond Grade DG³ barricade sheeting is applied to barricade blank materials in accordance with all 3M application and fabrication procedures provided in 3M's product bulletins, information folders and technical memos (which will be furnished upon request), including the exclusive use of 3M recommended application equipment; and if the barricade panel deteriorates within three years due to natural causes to the extent that:

1) the panel is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by drivers with normal vision, or 2) the coefficient of retroreflection is less than 50% of the values given in Table II, 3M's sole responsibility and purchaser's and user's exclusive remedy shall be that 3M will provide pro-rata replacement of the 3M materials.

Conditions

Such failure must be solely the result of design or manufacturing defects in the Diamond Grade™ DG³ barricade sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of application equipment not recommended by 3M; failure of substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the barricade panel; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement.

Replacement sheeting will carry the unexpired warranty of the sheeting it replaces.

Claims made under this warranty will be honored only if the panels have been dated at the time of sheeting application, which constitutes the start of the warranty period.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of failure.

Limitation of Liability

3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Literature

Sign Base Surface Preparation IF 1.7

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Electronic Only

Fluorescent Orange Prismatic Work Zone Sheeting Series 3924S Sheeting With Pressure Sensitive Adhesive

Product Bulletin 3924S **February 2012**

Replaces PB 3924S dated Oct. 2007

Description

3M™ Fluorescent Prismatic Reflective Sheeting Series 3924S is a microprismatic retroreflective sheeting designed for the production of durable traffic control signs for the work zone. The sheeting consists of prismatic lenses formed in a transparent resin, sealed, and backed with a pressure-sensitive adhesive and poly liner. Applied to properly prepared sign substrates, 3924S will provide long term service.

The pressure sensitive sheeting is available in roll widths up to 48 inches in a fluorescent orange work zone color.

Color	Product Code
Fluorescent Orange	3924S

Photometrics

Daytime Color (x,y,Y)

The chromaticity coordinates and luminance factor of the retroreflective sheeting conform to Table A below.

Color Test – Fluorescent Sheetings

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall be determined by instrumental method in accordance with ASTM E 991 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.[2]

[2]The instrumentally determined color values of retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the color Specification of Fluorescent Retroreflective materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer shall be the referee instrument.

Coefficients of Retroreflection (RA)

The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m2).

Table A - CIE Daytime Chromaticity Coordinate Limits[1]

	1		2		3		4		Luminance Factor Y (%) Min.
Color	x	y	x	y	x	y	x	y	
Orange	.583	.416	.535	.400	.595	.351	.645	.355	25

[1]The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colormetric System.

Test for Coefficients of Retroreflection

Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection of Retroreflective Sheeting" and per E-810 the values of 0° and 90° rotation are averaged to determine conformance to the R_A limits in Table B.

Table B - Minimum Coefficient of Retroreflection R_A for new fluorescent sheeting (cd/lux/m²)

-4° Entrance Angle[3]		
	Observation Angle[2]	
	0.2°	**0.5°**
Orange	230	75
30° Entrance Angle[3]		
	Observation Angle[2]	
	0.2°	**0.5°**
Orange	130	41

[2]Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[3]Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Adhesive

Series 3924S sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 60°F (16°C) or higher.

Adhesive and Film Properties

Standard Test Panels

Unless otherwise specified herein, sheeting shall be applied to test panels and conditioned in accordance with ASTM D4956 and test methods and conditions shall conform to ASTM D4956.

Properties

The following properties shall conform to the requirements in ASTM D4956.

1. Adhesion
2. Outdoor weathering
   - retained coefficient of retroreflection
   - colorfastness
3. Shrinkage
4. Flexibility
5. Liner removal
6. Impact resistance
7. Night time color

In addition, 3924S sheeting will conform to the following properties.

1. Gloss

Test Method – Test in accordance with ASTM D523 using a 60º glossmeter.

Requirement – Rating not less than 50.

2. Optical Stability

Test Method – Apply a 3 inch x 6 inch sample to a test panel. Measure R_A then place it in an oven at 71º C ± 3º C (160ºF ± 5ºF) for 24 hours followed by conditioning at standard conditions for 2 hours.
Remeasure R_A.
Requirement – The sheeting shall retain a minimum of 85% and a maximum of 115% of the original coefficient of retroreflection.

Sign Fabrication Methods

Application

Series 3924S incorporates a pressure-sensitive adhesive and should be applied to the sign substrate at room temperature (60°F/16°C) or higher by any of the following methods:

Mechanical squeeze roll applicator - IF 1.4

Hand squeeze roll applicator - IF 1.6

*Note - never direct the Calrod™ heater at the sheeting during application. If the heater is needed to warm to the minimum application temperature of 60°F, direct it at the substrate only.

Hand Application

Hand application is recommended for legend and copy only. Refer to 3M Information Folder 1.5 for more details.

Hand applications will show some visual irregularities, which are objectionable to aesthetically critical customers. To obtain a close-up uniform appearance, a roll laminator must be used.

Splices

Series 3924S sheeting must be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other. This is to prevent buckling as the sheeting expands in extreme temperature and humidity exposure.

Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extrusions. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

– Clean

– Smooth

– Flat

– Rigid

– Dimensionally stable

– Weather resistant

– Non-porous

– High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy such as polyethylene and other plastics will require additional preparation such as flame treatment (preferred), mechanical abrasion or use of adhesion promoters prior to sheeting application. Flat panels are to be carefully trimmed so that sheeting from adjacent panels does not touch on assembled signs.

3924S sheeting is designed primarily for applications to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is required; however, this product has a universal adhesive and can be used on plastic (flame treated) substrates. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Imaging

Series 3924S sheeting may be processed into traffic signs by any of the imaging methods described below. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or imaging materials other than those listed below.

Screen Processing

Series 3924S sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I or Series 880N. Series 880I or 880N process colors can be screened at 60-100ºF (16-38ºC) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. See Information Folder 1.8 for details. No clear coating is required and is not recommended. Use of other process colors series is not recommended. **Care should be taken to avoid flexing Series 3924S sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.**

3M™ ElectroCut™ Film

3M™ ElectroCut™ Film 1175 black may be used to provide copy for traffic control signs on 3924S sheeting. Refer to Product Bulletin 1170 for fabrication procedures.

Vinyl Graphic Films

Scotchcal™ Vinyl Series 3650, Series 7720 and Series 7725 may be used to provide copy for traffic control signs on 3924S sheeting. Refer to Scotchcal™ product literature for more information.

Latex Ink Jet Printing

Series 3924S sheeting may be imaged with HP 789 series black latex ink in conjunction with the HP Designjet L25500 Printer, or with 792 series black latex ink in conjunction with the HP Designjet L26500 Printer. Refer to Information Folder 3.4 for more information.

Note: With the exception of 3M branded products, 3M does not represent that any printer or printer accessory recommended in 3M literature will meet customer requirements, any federal, state or local regulations or any applicable safety standards. Such determination is the responsibility of the printer owner.

Cutting

3924S sheeting may be cut into letters and shapes of at least 3 inches in height and stroke widths of at least 1/2 inch. Smaller sizes are not recommended. Sealing cut edges of 3924S sheeting is not required.

Plotter Cutting

Programmable knife cut (electronic cutting)

1. Flat bed plotters can either die cut or kiss cut and offer the most consistently reliable performance.

2. Friction Fed plotter. Kiss cut only. Success has been achieved using plotters that have 600 grams of down force and a 60º cutting blade. Additional drive wheels may need to be added to improve tracking. An alternative procedure is to cut sheeting from the liner side. Blade force and knife depth must be set to score but not cut through the topfilm. Break apart individual copy or apply premask to retain spacing.

Other Cutting Methods

3924S sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Cutting equipment such as guillotines and metal shears, which have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing

it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting 3924S sheeting is 1 ½ inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. Refer to Information Folder 1.10.

Storage and Packaging

Series 3924S sheeting should be stored in a cool, dry area, preferably at 65-75ºF (18-24ºC) and 30-50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

Screen processed or printed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheet against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened or printed faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are required when twist style fasteners are used to mount the sign.

General Performance Considerations

The durability of 3924S sheeting and finished signs using 3M Matched Component materials will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Maximum durability of 3924S sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in Information Folder 1.7. The user must determine the suitability of any nonmetallic sign backing for its intended use. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M. Applications to unprimed, excessively rough or non-weather resistant surfaces or exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability.

3M has tested the HP Designjet Printers and black latex inks: L25500 printer/series 789 black ink, and L25600 printer/series 792 black ink; and when applied within parameters defined in IF 3.4 the resulting sign performance is considered to be commensurate with typically expected sign life. However, this imaging system is not covered as part of the 3M Matched Component system noted in the General Warranty Terms.

3M Basic Product Warranty and Limited Remedy

3M™ Fluorescent Work Zone Sheeting Series 3924S (“Product”) is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If 3924S Sheeting is proven not to have met the Basic Warranty on its shipment date, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, will be refund or replacement of the sheeting.

General Warranty Terms:

1. 3M makes the Additional Warranty (as defined below) as to any traffic control and guidance sign in the United States and Canada (“Sign”) made with 3M™ Fluorescent Work Zone Sheeting Series 3924S (“Product”) and the Matched Component materials listed in Table D. Any Additional Warranty is contingent on all components involved in that Additional Warranty being stored, applied, installed, and used only as 3M recommends in its Product Bulletins and Other Product Information.

2. The Basic Warranty and any applicable Additional Warranty are collectively referred to as the “3M Warranty.” EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, RIGHTS OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND THOSE ARISING

FROM A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. A BUYER IS RESPONSIBLE FOR DETERMINING IF A PRODUCT IS SUITABLE FOR ITS PARTICULAR PURPOSE AND APPLICATION METHODS.

3. A Sign's failure to meet the 3M Warranty must be solely the result of the Product or the matched component materials' design or manufacturing defects. 3M has no obligation under the 3M Warranty if a sign failure is caused by:

improper fabrication, handling, maintenance or installation; non-vertical applications where the Sign face is more than +/- 10% from vertical; use of any material or product not made by 3M or not included in Table D; use of application equipment not recommended by 3M; failure of sign substrate; loss of adhesion due to incompatible or improperly prepared substrate; exposure to chemicals, abrasion and other mechanical damage; snow burial or any other sign burial; collisions, vandalism or malicious mischief.

4. 3M reserves the right to determine the method of replacement, and any replacement Product will have the remainder of the original Product's unexpired 3M Warranty. Claims made under this warranty will be honored only if

– The Sign was dated upon completion of fabrication ("Fabrication Date") using a permanent method (sticker, permanent marker or crayon, metal stamp, etc.)

– 3M is notified of a 3M Warranty claim during any applicable Warranty Period and the owner or fabricator provides the information reasonably required by 3M to verify if a 3M Warranty is applicable.

Additional Warranty and Limited Remedy

1. The Additional Warranty for a Sign made with the Product is that the Sign will: (a) remain effective for its intended use when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision, and (b) after cleaning, will meet the minimum values for coefficient of retroreflection stated in Table C for three years measured from the Sign's Fabrication Date.

• R_A shall be measured per ASTM E810.

• All measurements shall be made after cleaning according to 3M recommendations.

2. If any Sign made with the Product is proven not to have met the Additional Warranty, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option, is that 3M will provide pro-rated replacement of the 3M materials.

Table C
Minimum Coefficient of Retroreflection and Luminance Factors
(All measurements shall be made after cleaning according to 3M recommendations)

	Minimum Coefficient of Retroreflection (R_A) cd/lux/m² at -4° Entrance Angle		Minimum Luminance Factor (Y)
Color	Observation Angle	R_A	%
Orange	0.2	115	25

Table D. Matched Component Materials.

Matched Components	
Process Colors	Series 880I
Process Colors	Series 880N
ElectroCut™ Film	Series 1170
3M Scotchcal™ Black Vinyl Film	Series 3650, 7720, 7725
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

Refer to 3M Information Folders and Product Bulletins for detailed information about recommended application procedures and equipment.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/or product label of any materials prior to handling or use.

Other Product Information

Always confirm that you have the most current version of the applicable Product Bulletin, Information Folder or Other Product Information.

IF 1.4	Instructions for Interstate Squeeze Roll Applicator
IF 1.5	Hand Application Instructions
IF 1.6	Hand Squeeze Roll Applicator
IF 1.7	Sign Base Surface Preparation
IF 1.8	Process Color Application Instructions
IF 1.10	Cutting, Premasking, and Prespacing
IF 1.11	Sign Maintenance Management
PB 880I	Process Color 880I
PB 880N	Process Color 880N
PB 1170	ElectroCut™ Film
IF 3.4	Ink Jet Imaging with HP Designjet L25500 Printer and HP 789 Series latex Inks

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3M Diamond Grade™ Fluorescent VIP Reflective Sheeting

Visual Impact Performance (VIP) Series 3980

Product Bulletin 3980 **September 2005**

Replaces PB 3980 dated November 2002

Description

3M™ Diamond Grade™ Fluorescent VIP Reflective Sheeting is a visible-activated fluorescent wide angle prismatic lens reflective sheeting designed for the production of durable traffic control signs and delineators that are exposed vertically in service. This sheeting is designed to provide higher nighttime sign brightness than sheetings that use glass bead lenses and higher daytime brightness than ordinary (non-fluorescent) colored sheetings. It is intended to also provide high sign brightness in the legibility distance where other sheetings do not. This feature is shown by the values at 1.0° observation angle in Table C which represents these viewing geometrys. VIP sheeting also provides brightness at high entrance angles shown by the values at 40° in Table C. Applied to properly prepared sign backings, fluorescent VIP sheeting should provide long term service.

Color	Product Code
Fluorescent Yellow	3981
Fluorescent Yellow Green	3983

Photometrics

Daytime Color (x,y,Y)
The chromaticity coordinates and total luminance factor of the retroreflective sheeting conform to Table A.

Color Test
Conformance to daytime color requirements of Table A shall be determined instrumentally on sheeting applied to aluminum test panels, using a 2-monochromator spectrophotometer employing annular 45/0 illuminating and viewing geometry[1]. The bispectral radiance factor matrix (Donaldson matrix) shall be obtained in accordance with ASTM E 2153 “Practice for Obtaining Bispectral Photometric Data for Evaluation of Fluorescent Color”. The total chromaticity coordinates and total luminance factor shall be computed from the Donaldson matrix in accordance with ASTM E2152 “Practice for Computing the Colors of Fluorescent Objects from Bispectral Data” for CIE illuminant D65 and the CIE 1931 (2°) standard colorimetric observer. The measurements shall be made on a Labsphere BFC-450 Bispectral Fluorescence Colorimeter or equivalent.

Table A - CIE Daytime Chromaticity Coordinate Limits* and Total Luminance Factor Minimum

Color	x	y	x	y	x	y	x	y	Total Luminance Factor Y (%) Min.
Yellow	.521	.424	.557	.442	.479	.520	.454	.491	45
Yellow Green	.390	.610	.460	.540	.421	.486	.368	.539	60

*The four pairs of chromaticity coordinates define the acceptable color limits for CIE D65 illumination in terms of the CIE 1931 Standard Colorimetric System when measured using a 2-monochromator spectophotometer employing annular 45/0 illuminating and viewing geometry.

Fluorescence (Y_F)
Fluorescent luminance properties differentiate fluorescent sheeting from ordinary (non-fluorescent) sheeting. The Fluorescence Luminance Factor, Y_F, provides a standardized measure of the sheeting fluorescent properties. The numerical value of Y_F sheeting under specified illumination and viewing conditions verifies the fluorescent properties of the sign sheeting (for non-fluorescent sheeting Y_F=0). The minimum fluorescence luminance factor (Y_F) values of the retroreflective sheeting conform to Table B.

Table B - Fluorescence Luminance Factor Minimum for New Sheeting

Color	Y_F (%) min.
Yellow	25
Yellow Green	35

Fluorescence Test
Conformance to fluorescence luminance factor requirements shall be determined instrumentally, on sheeting applied to aluminum test panels, using a 2-monochromator spectrophotometer employing annular 45/0 (or equivalent 0/45) illuminating and viewing geometry.[1&2] The fluorescence luminance factor shall be calculated from the fluorescence spectral radiance factors computed for CIE illuminant D65 in accordance with ASTM E-308 "Practice for Computing the Colors of Objects by Using the CIE System" for the CIE 1931 (2˚) standard colorimetric observer. The measurements shall be made on a Labsphere BFC-450 Bispectral Fluorescence Colorimeter or equivalent.

[1] "Design and testing of a two-monochromator reference spectrofluorimeter for high-accuracy total radiance factor measurements" by Joanne C. Zwinkels, D.S. Gignac, M. Nevins, I. Powell, and A. Bewsher, Applied Optics, Vol. 36 no. 4, pp. 892-902 (1997).

[2] "Principles of Bispectral Fluorescence Colorimetry" by Jim Leland, N. Johnson, and A. Arecchi, Proceedings of SPIE - The International Society for Optical Engineering: Vol. 3140, pp. 76-87 (1997).

Coefficients of Retroreflection (R_A)
The values in Table C are miniumum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m^2).

Test for Coefficients of Retroreflection
Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection of Retroreflective Sheeting", and per E-810 the values of 0˚ and 90˚ rotation are averaged to determine the R_A in Table C.

Table C - Minimum Coefficient of Retroreflection R_A for New Sheeting (cd/lux/m^2)

Sheeting	Observation[3] Angle	Entrance Angle[4] -4˚	30˚	40˚
Fluorescent Yellow	0.2˚	240	150	55
	0.5˚	165	81	15
	1.0˚	48	27	6
Fluorescent Yellow Green	0.2˚	325	200	75
	0.5˚	236	110	23
	1.0˚	65	36	9

[3] Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[4] Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Nighttime Color (x,y)
The chromaticity coordinates of the reflective sheeting conform to Table D.

Nighttime Color Test
Conformance to nighttime color requirements shall be determined instrumentally on sheeting applied to aluminum test panels. Testing shall be in accordance with ASTM E-811. The total chromaticity coordinates shall be calculated from the total spectral radiance factors measured under

Table D - Nighttime Color Specification Limits For New Sheeting* Chromaticity Coordinate

Color	x	y	x	y	x	y	x	y
Fluorescent Yellow	0.554	0.445	0.610	0.390	0.569	0.394	0.527	0.436
Fluorescent Yellow Green	0.480	0.520	0.550	0.449	0.524	0.439	0.472	0.492

*The four pairs of chromaticity coordintes determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with CIE standard illuminant A.

CIE illuminant A and computed in accordance with ASTM E-308 “Practice for Computing the Colors of Objects by Using the CIE System” for the CIE 1931 (2˚) standard colorimetric observer.

Orientation

Diamond Grade fluorescent VIP sheeting is designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or ultimate orientation after installation. However, because the efficiency of light return from cube corner reflectors is not equal at all rotation angles, it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular way.

When extra wide entrance angle performance is important for a given sign type or situation, you may elect to make the signs with a specific orientation. However, unless the location and/or position calls for extra-wide entrance angularity performance signs can be manufactured and installed using the orientation that most efficiently utilizes the reflective sheeting.

For purposes of test measurement of the sheeting, it is important for the material to have a datum mark (the orientation arrows) so that the sample can be properly oriented in the test machinery. In those situations where extra wide entrance angle performance is required, this arrow can be used to assure the preferred orientation.

Interlocking Diamond Seal Pattern

Series 3980 sheeting has the same interlocking seal pattern as series 3990 sheeting. This pattern is unique to 3M wide angle prismatic retroreflective sheetings. Because of the small cube corners used in series 3980 sheeting, the seal cell walls or “legs” appear smooth.

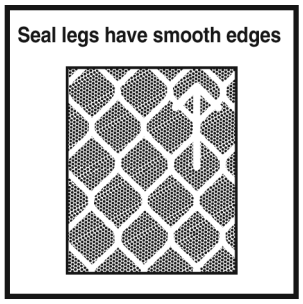

Figure 1 - Sheeting is positioned at a 0° angle.

Datum Marks (Arrows)

Series 3980 sheeting is made with small arrows in the surface repeated down the roll staggered at 20 inches and across the roll at regular intervals (Figure 2). These arrows which point down the length of the roll serve as reference marks for photometric testing. The arrows are also used as visual aids to sheeting orientation when fabricating signs for special high entrance angle situations. The design of these arrows differentiate VIP sheeting from other Diamond Grade sheetings.

Tooling Lines

The manufacturing of a prismatic sheeting results in tooling lines being present in the product. In Diamond Grade fluorescent VIP sheeting these lines are slightly thicker than the seal pattern legs. Tooling lines are noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 2).

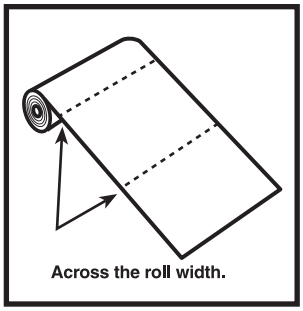

Figure 2 - Tooling Lines

Adhesive

Series 3980 sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 65˚F (18˚C) or higher.

Test Methods of Adhesive and Film

Standard Test Panels

Unless otherwise specified, herein, sheeting shall be applied to test panels in accordance with ASTM D4956-01, section 7.2 and test conditions shall conform to ASTM D4956 section 7.1.

Properties

Standard Conditioning - all mounted and unmounted test specimens shall be conditioned for 24 hours at 73˚F ± 2˚F (23˚C ± 1˚C) and 50% ± 4% R.H. before testing.

1. Adhesive

The retroreflective sheeting shall comply with the liner removal and adhesion requirements contained in ASTM D4956 sections 7.10 and 7.5 respectively.

2. Impact Resistance

Test Method - Apply sheeting to a standard panel 3 inch x 6 inch (7.6x15.2cm) and condition. Subject sheeting to a 50 inch pounds (5.7Nm) impact in accordance with ASTM D-2794.

Requirement - No separation from panel or cracking outside immediate impact area.

3. Shrinkage

The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D4956 sections 7.10 and 7.5 respectively.

4. Flexibility

Test Method - Following conditioning of 1 inch x 6 inch sample, remove liner and dust adhesive with talc. At standard conditions, bend in one second around 1/8 inch (3.2mm) mandrel with adhesive side facing mandrel.

Requirement - No cracking, peeling or delamination.

5. Gloss

Test Method - Test in accordance with ASTM D523 using an 85˚ glossmeter.

Requirement - Rating not less than 50.

6. Optical Stability

Test Method - Apply sheeting to standard panel and condition. Measure coefficients of retroreflection for all test geometries. Expose panel in an air circulating oven at 160± 5˚F (71± 3˚C) for a period of 24 hours. Re-condition after exposure and re-measure at all test geometries.

Requirement - Coefficients of retroreflection measured after exposure shall be beween 85% and 115% of the values measured before exposure.

Sign Fabrication Methods

Application

Diamond Grade fluorescent VIP sheeting series 3980 incorporates a pressure-sensitive adhesive and should be applied to the sign substrate at room temperature (65˚F/18˚C) or higher by any of the following methods:

Mechanical squeeze roll applicator - IF 1.4*

Application to extrusions requires heat directed at the next-to-last edge roller. Cracking may occur if the top film is not sufficiently softened.

Hand squeeze roll applicator - IF 1.6

Hand application - IF 1.5

*Note - never direct the Calrod™ heater at the sheeting during application. If the heater is needed to warm to the minimum application temperature of 65˚F, direct it at the substrate only.

Hand Application

Hand application is recommended for legend and copy only. Application of Diamond Grade sheeting for complete signs or backgrounds must be done with a roll laminator, either mechanical or hand. See Information Folder 1.5 for more details.

Hand applications will show some visual irregularities which are objectionable to aesthetically critical customers. These are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.

All direct applied copy and border MUST be cut at all metal joints and squeegeed at the joint.

Splices

Series 3980 sheeting should be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other at the splice and a gap of up to 1/16 inch is acceptable. This is to prevent buckling as the sheeting expands in extreme temperature/
humidity exposure.

If the visual appearance of the splice is important or a slight gap is undesirable, the following procedures must be followed:

1. Overlap the sheeting at least one inch, with or without the liner attached.
2. Using a straight edge and a sharp utility knife, cut through both layers of reflective sheeting.
3. Peel back and remove cut remnants. If liner was left on, remove and roll down remaining sheeting.
4. Seal edge with thinned 880 Clear using a fine artist paint brush.

Double Faced Signs

Series 3980 sheeting on the first side must be protected from damage from the steel bottom roll of squeeze roll applicators with FR-2 sponge rubber and SCW82.

Substrates

For traffic sign use, product application is limited to properly prepared aluminum (see Information Folder 1.7). Extrusions are to be wrapped, and flat panel signs are to be carefully trimmed so that sheeting from adjacent panels do not touch on the assembled signs. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Diamond Grade fluorescent VIP sheeting is designed primarily for application to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is essential. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Screen Processing

Fluorescent VIP sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M™ Process Colors Series 880 (see Product Bulletin 880).

Series 880 process colors can be screen processed at 60-100˚F (16-38˚C) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. See Information Folder 1.8 for details. Use of other process colors series is not recommended.

3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or 3M process colors other than those listed above.

Care should be taken to avoid flexing the sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.

Cutting and Matching

The sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. VIP sheeting can be hand cut from either side with a razor blade or other sharp hand tool. Like all reflective sheetings, when two or more pieces are used side by side on a sign, they must be matched to assure uniform day color and night appearance.

Cutting equipment such as guillotines and metal shears which have pressure plates on the sheeting when cutting may damage the optics. Padding the pressure plate and easing significantly reduces it down onto the sheets being cut will eliminate damage. Maximum stack height for cutting VIP sheeting is 1-1/2 inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

Multi-piece signs should have all panels or pieces oriented identically for uniform appearance (arrow and the seal pattern in the same direction).

Edge sealing VIP sheeting is generally not required. Following extended exposure, airborne dust particles may become trapped within the row of cut cells along the sheeting edge. This should have no adverse effect on sign performance. If the user chooses to edge seal, series 880 toner should be used.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

General Performance Considerations

The durability of Diamond Grade fluorescent VIP reflective sheeting Series 3980 will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

Maximum durability of Series 3980 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in Information Folder 1.7 on Sign Substrate Surface Preparation.

The user must determine the suitability of any nonmetallic sign backing for its intended use. Applications to unprimed, excessively rough or non-weather-resistant surfaces, or exposure to severe or unusual conditions can shorten the performance in such applications.

Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability.

Color stability - Diamond Grade fluorescent VIP sheeting will change in color appearance at a rate comparable to non-fluorescent sheeting during the warranty period.

After the warranty period, the color of fluorescent VIP sheeting may degrade more rapidly than nonfluorescent sheeting. The rate of fluorescent degradation is accelerated in climates with high levels of solar irradiation and high temperatures. Color changes may be expected to first appear on south-facing signs.

Periodic sign inspection and regular sign replacement are strongly recommended in order for agencies to establish their own effective service life expectation, beyond the warranty period.

3M™ Scotchcal™ Film 3655 Black, Scotchcal film 7720-12, 3M™ Controltac™ Film 180-12 Black, and 3M™ Electrocut™ Film Series 1170 can be expected to perform satisfactorily for the life of the sign when direct applied to series 3980 sheeting, except where shortened durability is stated in the literature.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. See Information Folder 1.10.

Storage and Packaging

Fluorescent VIP sheeting should be stored in a cool, dry area, preferably at 65-75˚F (18-24˚C) and 30-50% relative humidity and should be applied within one year of purchase.

Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheeting against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face. Packages of finished sign faces must include sufficient nylon washers for mounting.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. See Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are recommended between the heads of all twist fasteners (such as screw heads, bolts, or nuts) and the sheeting to protect the sheeting from the twisting action of the bolt heads.

Warranty

3M warrants that Diamond Grade™ Fluorescent VIP Reflective Sheeting Series 3980, sold by 3M after June 1, 2000, to be used as components for traffic control and guidance signs in the United States and Canada will remain effective for its intended use for ten years* (see footnote for warranty exceptions), subject to the following provisions.

If a Diamond Grade fluorescent sign surface is processed and applied to sign blank materials in accordance with all 3M application and fabrication procedures found in 3M's product bulletins, information folders and technical memos (which will be furnished to the agency upon request), including the exclusive use of 3M matched component systems, process colors, clear coatings, electronic cuttable films, 1160 protective overlay films, and recommended application equipment; and if the sign deteriorates due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision; or (2) the coefficient of retroreflection, after cleaning, is less than the minimums specified in Table E; or (3) the total luminance factor and the fluorescence luminance factor, after cleaning, are less than the minimums specified in Table E; or (4) the daytime chromaticity, after cleaning, falls outside the limits specified in Table A; or (5) the nighttime chromaticity, after cleaning, falls outside the limits specified in Table D; 3M's sole responsibility and purchaser's and user's exclusive remedy will be:

For those states with a 10 year warranty, if the failure occurs within the first 7 years from the date of fabrication, 3M will, at its expense, restore the sign surface to its original effectiveness. If the failure occurs in the 8th through the 10th year from the date of fabrication, 3M will furnish the necessary amount of Diamond Grade fluorescent

Table E - Minimum Coefficient of Retroreflection and Luminance Factors
(All measurements shall be made after cleaning according to 3M recommendations.)

Color	Minimum Coefficient of Retained Retroreflection (R_A) cd/lux/m^2 at -4° Entrance Angle		Minimum Fluorescent Luminance Factor Y_F %	Minimum Total Luminance Factor Y_T %
	Observation Angle	R_A		
Yellow	0.2°	165	20	45
	1.0°	30		
Yellow Green	0.2°	225	20	60
	1.0°	45		

* Due to climatic conditions, the warranty for Alabama, Arizona, Florida, Georgia, Hawaii, Louisiana, Mississippi, New Mexico, South Carolina, and Texas will to be seven years.

sheeting to restore the sign surface to its original effectiveness.

For those states with a 7 year warranty, if the failure occurs within the first 5 years from the date of fabrication, 3M will, at its expense, restore the sign surface to its original effectiveness. If the failure occurs in the 6th or 7th year from the date of fabrication, 3M will furnish the necessary amount of Diamond Grade fluorescent sheeting to restore the sign surface to its original effectiveness.

Conditions

Such failure must be solely the result of design or manufacturing defects in the Diamond Grade fluorescent reflective sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of process colors, thinner, coatings, or overlay films and sheetings not made by 3M; use of application equipment not recommended by 3M; failure of sign substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the sign; snow burial; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement.

Replacement sheeting will carry the unexpired warranty of the sheeting it replaces.

Claims made under this warranty will be honored only if the signs have been dated at the time of sheeting application, which constitutes the start of the warranty period.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, (reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of failure.)

Limitation of Liability

3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Literature Reference

Instructions for Squeeze Roll Applicator	IF 1.3
Hand Application Instructions	IF 1.5
Instructions for Hand Squeeze Roll Applicator	IF 1.6
Sign Base Materials	IF 1.7
Color Application Instructions	IF 1.8
Cutting, Matching, Premasking, and Prespacing Instructions	IF 1.10
Storage Maintenance, and Removal Instructions	IF 1.11
Sign Fabrication Guidelines for Maximizing Legibility and for High Entrance Angle Signs	
Process Colors	PB 880

ASTM Test Methods are available from ASTM International, West Conshohoken, PA.

FOR INFORMATION OR ASSISTANCE CALL:
1-800-553-1380

IN CANADA CALL:
1-800-265-1840

Fax-on-Demand in the U.S. and Canada:
1-800-887-3238

Internet:
www.3M.com/tss

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith.

Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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3M
Diamond Grade™ DG³ Reflective Sheeting Series 4000

Product Bulletin 4000 **January 2012**

Description

3M™ Diamond Grade™ DG³ Reflective Sheeting Series 4000 is a super-high efficiency, full cube retroreflective sheeting designed for the production of traffic control signs and delineators that are exposed vertically in service. DG³ sheeting is designed to have the highest retroreflective characteristics at medium and short road distances as determined by the R_A values at 0.5° and 1.0° observation angles in Table B. Performance at these observation angles represents the most common nighttime viewing geometries encountered by the driving public. During the daytime, Diamond Grade DG³ fluorescent reflective sheeting provides higher visibility than ordinary (non-fluorescent) colored sheetings.

Applied to properly prepared sign substrates Diamond Grade DG³ reflective sheeting provides long-term retroreflectivity and durability. Series 4000 sheeting is available in the following colors.

Color	Product Code
White	4090
Yellow	4091
Red	4092
Blue	4095
Green	4097
Brown	4099
Fluorescent Yellow - FY	4081
Fluorescent Yellow Green- FYG	4083
Fluorescent Orange - FO	4084

Color	Product Code
White - thermal transfer printable	4090TT
Yellow - thermal transfer printable	4091TT
Fluorescent Yellow - TT printable	4081TT
Fluorescent Yellow - Green - TT printable	4083TT

Photometrics

Daytime Color (x, y, Y)

The chromaticity coordinates and total luminance factor of the retroreflective sheeting conform to Table A.

Color Test – Fluorescent Sheetings

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall be determined by instrumental method in accordance with ASTM E 991 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.[2]

Color Test – Ordinary Colored Sheeting

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.[2]

Table A - Daytime Color Specification Limits[1]

									Daytime Luminance Limit (Y%)	
Color	x	y	x	y	x	y	x	y	Min.	Max.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	27	
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	15	45
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	15
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	3	12
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390	1	9
FY	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	40	
FYG	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	60	
FO	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	20	

[1]The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Colorimetric System.

[2]The instrumentally determined color values of retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the Color Specification of Fluorescent Retroreflective Materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer shall be the referee instrument.

Coefficients of Retroreflection (R_A)
The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m^2).

Test for Coefficients of Retroreflection
Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection of Retroreflective Sheeting", and per E-810 the values of 0º and 90º rotation are averaged to determine the R_A in Table B.

Table B - Minimum Coefficient of Retroreflection R_A for new sheeting (cd/lux/m^2)

-4º Entrance Angle[3]			
	Observation Angle[4]		
	0.2º	**0.5º**	**1.0º**
White	580	420	120
Yellow	435	315	90
Red	87	63	18
Green	58	42	12
Blue	26	19	5
Brown	17	13	4
Fluorescent Yellow	350	250	72
Fluorescent Yellow Green	460	340	96
Fluorescent Orange	175	125	36
30º Entrance Angle[3]			
	0.2º	**0.5º**	**1.0º**
White	220	150	45
Yellow	165	110	34
Red	33	23	7
Green	22	15	5
Blue	10	7	2
Brown	7	5	1
Fluorescent Yellow	130	90	27
Fluorescent Yellow Green	180	120	36
Fluorescent Orange	66	45	14

[3] Entrance Angle – The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.
[4] Observation Angle – The angle between the illumination axis and the observation axis.

Printed Colors and Overlay Films

For screenprinted or thermally transfer printed transparent color areas on white sheeting when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 70% of the value for the corresponding color in Table B. For white sheeting covered with 3M™ ElectroCut™ Film Series 1170 when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 100% of the value for the corresponding color in Table B. The color chromaticity and luminance shall conform to Table A on page 1.

Entrance Angularity Performance in Regard to Orientation

Diamond Grade DG[3] Reflective Sheeting is designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or ultimate orientation of the sign after installation. However, because the efficiency of light return from cube corner reflectors is not equal at all application orientations, especially with increasing entrance angles, it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular manner. When high entrance angle (>50º) performance is required for given signs (e.g. Keep Right Symbols), it can be obtained easily by specifying the application orientation of the completed signs. In these situations the completed sign should have the sheeting positioned at the 0º orientation (downweb direction perpendicular to the road).

When the "primary groove line" (or, flat side of the diamond shape) is vertical in the completed sign, sheeting is said to be at a 0º orientation. When the "primary groove line" (or, flat side of the diamond shape) is horizontal in the completed sign, the sheeting is said to be at a 90º orientation. (Figure 1)

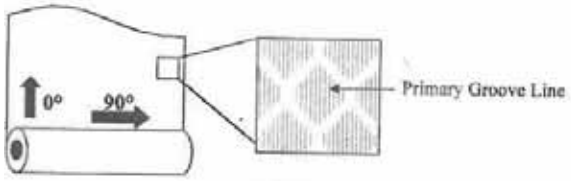

Figure 1

Unless the sign location and/or position calls for extra-wide entrance angularity performance, signs and applied copy (letters, arrows, borders and shields) can be fabricated and installed using the application orientation that most efficiently utilizes the reflective sheeting.

Note: For multi-panel signs it is recommended that all background panels be sheeted such that the sheeting direction is the same for all panels.

Fabrication Lines

The manufacture of prismatic sheeting results in lines being present in the product. In Diamond Grade DG^3 sheeting these lines are slightly thicker than the seal pattern legs. Fabrication lines are noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 2).

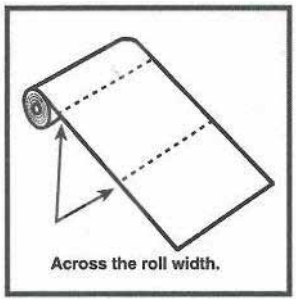

Figure 2 - Fabrication Lines

Adhesive

Diamond Grade DG^3 sheeting has a pressure-sensitive adhesive that is recommended for application at temperatures of 65ºF (18ºC) or higher.

Adhesive and Film Properties

Standard Test Panels

Unless otherwise specified herein, sheeting shall be applied to test panels and conditioned in accordance with ASTM D4956 and test methods and conditions shall conform to ASTM D4956.

Properties

The following properties shall conform to the requirements in ASTM D4956.

1. Adhesion
2. Outdoor weathering
   - retained coefficient of retroreflection
   - colorfastness
3. Shrinkage
4. Flexibility
5. Liner removal
6. Impact resistance
7. Night time color

In addition, DG^3 sheeting will conform to the following properties.

1. Gloss

Test Method – Test in accordance with ASTM D523 using a 60º glossmeter.
Requirement – Rating not less than 50.

2. Optical Stability

Test Method – Apply a 3-inch x 6-inch sample to a test panel. Measure R_A then place it in an oven at 71º C ± 3º C (160ºF ± 5ºF) for 24 hours followed by conditioning at standard conditions for two hours. Remeasure R_A.
Requirement – The sheeting shall retain a minimum of 85% and a maximum of 115% of the original coefficient of retroreflection.

Sign Fabrication Methods

Application

Diamond Grade DG^3 sheeting incorporates a pressure sensitive adhesive and should be applied to the sign substrate at temperature of 65ºF/18ºC or higher by any of the following methods:

Mechanical squeeze roll applicator – refer to 3M Information Folder (IF) 1.4. Application to extrusions that are edge wrapped requires sufficient softening of the sheeting. This can be accomplished by directing additional heat to the “next to last” edge roller. This practice will increase productivity and minimize cracking.

Hand squeeze roll applicator – refer to 3M IF 1.6.

Application of Diamond Grade DG^3 sheeting for complete signs or backgrounds must be done with a roll laminator, either mechanical or hand driven.

Hand Application

Hand application is recommended for legend and copy only. Refer to 3M Information Folder 1.5 for more details.

Hand applications will show some visual irregularities, which are objectionable to aesthetically critical customers. These are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.

All direct applied copy and border MUST be cut at all metal joints and squeegeed at the joints.

Splices

Series 4000 sheeting must be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other. This is to prevent buckling as the sheeting expands in extreme temperature and humidity exposure.

Double Faced Signs

The sheeting on the bottom side of a double faced sign can be damaged if rolled through a squeeze roll applicator with an unprotected steel bottom roller. The use of a semi-soft flat sheet between the steel roller and the applied sign face will provide protection from damage. A material such as a rubber mat, tag board or cardboard is recommended.

Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extrusions. **Users are urged to carefully evaluate all other substrates for adhesion and sign durability.** Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

– Clean
– Smooth
– Flat
– Rigid
– Dimensionally stable
– Weather resistant
– Non-porous
– High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy may require additional preparation such as flame treatment, mechanical abrasion or use of adhesion promoters prior to sheeting application. Guide sign extrusions may be edge wrapped. Flat panels or unwrapped extrusions are to be carefully trimmed so that sheeting from adjacent panels does not touch on assembled signs.

Diamond Grade DG^3 sheeting is designed primarily for applications to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is required. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.**

Imaging

Diamond Grade DG^3 sheeting may be processed into traffic signs by any of the imaging methods described below. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or matched component imaging materials other than those listed below.

Screen Processing

Diamond Grade DG^3 sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I or Series 880N. Series 880I or 880N process colors can be screened at 60-100ºF (16-38ºC) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. Refer to Information Folder 1.8 for details. No clear coating is required or recommended. Use of other process colors series is not recommended.

Care should be taken to avoid flexing DG^3 sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.

Thermal Transfer Printing

Diamond Grade DG^3 TT sheeting may be imaged with 3M™ Thermal Transfer Ribbon Series TTR2300 in conjunction with the Matan SprinG3 or Matan Spot4 thermal transfer printers. For regulated traffic signs, Series TTR2300 Spot Traffic Colors are to be applied using these printers and must be covered with 3M™ ElectroCut™ Film 1170. Refer to Product Bulletin TTR2300 for more information.

3M™ ElectroCut™ Film

3M™ ElectroCut™ Film Series 1170 may be used to provide transparent colored background copy for traffic control signs on Diamond Grade DG^3 sheeting. Refer to Product Bulletin 1170 for fabrication procedures.

Applied Cut-Out Copy

Diamond Grade DG^3 cut letters may be applied to a DG^3 sheeting background to create a sign legend. Such cut-out copy may be directly applied to the background sheeting, or may be applied in a demountable form. Direct applied copy must be cut at all panel seams and carefully trimmed back so that sheeting from adjacent panels does not touch on assembled signs. Refer to Information Folder 1.10 for more information.

Note: It is recommended to fabricate all but the largest signs using 1170 electronic cuttable overlay film instead of direct applied copy.

Cutting

Diamond Grade DG^3 sheeting may be cut into letters and shapes of at least three inches in height and stroke widths of at least one half inch. Smaller sizes are not recommended. Sealing cut edges of DG^3 sheeting is not required.

Plotter Cutting

Programmable knife cut (electronic cutting)

1. Flat bed plotters can either die cut or kiss cut and offer the most consistent and reliable performance.
2. Friction Fed plotter. Kiss cut only. Success has been achieved using plotters that have 600 grams of down force and a 60º cutting blade. Additional drive wheels may need to be added to improve tracking. An alternative procedure is to cut sheeting from the liner side. Blade force and knife depth must be set to score but not cut through the topfilm. Break apart individual copy or apply premask to retain spacing.

Other Cutting Methods
Diamond Grade DG^3 sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Cutting equipment such as guillotines and metal shears, which have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting Series 4000 sheeting is 1½ inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

Storage and Packaging

3M Diamond Grade DG^3 Sheeting should be stored in a cool, dry area, preferably at 65-75ºF (18-24ºC) and 30-50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheet against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are required when twist style fasteners are used to mount the sign.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. Refer to 3M Information Folder 1.10.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/or product label of any materials prior to handling or use.

General Performance Considerations

The durability of Diamond Grade DG^3 sheeting and finished signs using 3M Matched Component materials will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Maximum durability of Diamond Grade DG^3 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in Information Folder 1.7. The user must determine the suitability of any nonmetallic sign backing for its intended use. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.** Applications to unprimed, excessively rough or non-weather resistant surfaces or exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. 3M process colors and ElectroCut™ Film, when used according to 3M recommendations, are generally expected to provide performance comparable to colored reflective sheeting. Custom colors, certain lighter colors, heavily toned colors or blends containing yellow or gold may have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability.

Periodic sign inspection and regular sign replacement are strongly recommended in order for sign owners to establish their own effective service life expectation, beyond the warranty period.

3M Basic Product Warranty and Limited Remedy

3M™ Diamond Grade™ DG^3 Reflective Sheeting Series 4000 (“Product”) is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If DG^3 Sheeting is proven not to have met the Basic Warranty on its shipment date, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, will be refund or replacement of the sheeting.

General Warranty Terms:

1. 3M makes the Additional Warranty (as defined below) as to any traffic control and guidance sign in the United States and Canada ("Sign") made with 3M™ Diamond Grade™ DG^3 Reflective Sheeting Series 4000 ("Product") and the Matched Component materials listed in Table E. Any Additional Warranty is contingent on all components involved in that Additional Warranty being stored, applied, installed, and used only as 3M recommends in its Product Bulletins and Other Product Information.

2. The Basic Warranty and any applicable Additional Warranty are collectively referred to as the "3M Warranty." EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, RIGHTS OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND THOSE ARISING FROM A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. A BUYER IS RESPONSIBLE FOR DETERMINING IF A PRODUCT IS SUITABLE FOR ITS PARTICULAR PURPOSE AND APPLICATION METHODS.

3. A Sign's failure to meet the 3M Warranty must be solely the result of the Product or the matched component materials' design or manufacturing defects. 3M has no obligation under the 3M Warranty if a sign failure is caused by:

improper fabrication, handling, maintenance or installation; non-vertical applications where the Sign face is more than +/- 10% from vertical; use of any material or product not made by 3M or not included in Table E; use of application equipment not recommended by 3M; failure of sign substrate; loss of adhesion due to incompatible or improperly prepared substrate; exposure to chemicals, abrasion and other mechanical damage; snow burial or any other sign burial; collisions, vandalism or malicious mischief.

4. 3M reserves the right to determine the method of replacement, and any replacement Product will have the remainder of the original Product's unexpired 3M Warranty. Claims made under this warranty will be honored only if

–The Sign was dated upon completion of fabrication ("Fabrication Date") using a permanent method (sticker, permanent marker or crayon, metal stamp, etc.)

–3M is notified of a 3M Warranty claim during any applicable Warranty Period and the owner or fabricator provides the information reasonably required by 3M to verify if a 3M Warranty is applicable.

Additional Warranty & Limited Remedy for Ordinary colored Product

1. The Additional Warranty for a Sign made with ordinary colored Product is that the Sign will: (a) **remain effective for its intended use when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision,** and (b) after cleaning, will meet the **minimum values for coefficient of retroreflection stated in Table C** for Table C's applicable Warranty Period measured from the Sign's Fabrication Date.

Table C – Minimum Percent Retained of Table B Initial R_A for applicable Warranty Period for Ordinary Colors (white, yellow, red, green, blue and brown)

Warranty Period	Minimum Percentage R_A Retained
1-7 Years	80%
8-12 Years	70%

2. If any Sign made with Ordinary Product is proven not to have met the Additional Warranty, then a buyer's **exclusive remedy**, and 3M's sole obligation, at 3M's option:

(a) if this occurs within seven years after the Fabrication Date, then 3M will, at its expense, restore the Sign's surface to its **original effectiveness;** or

(b) if this occurs during the remainder of the Additional Warranty Period, then 3M will furnish only the necessary 3M sheeting Product and matched component materials quantity to restore the Sign's surface to its original effectiveness.

Additional Warranty & Limited Remedy for Fluorescent Product

1. The Additional Warranty for a Sign made with Fluorescent Product is that the Sign will: (a) **remain effective for its intended use when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision;** (b) after cleaning, will **retain 70% of the minimum values for coefficient of retroreflection stated in Table B** for the applicable Warranty Period stated in Table D, measured from Fabrication Date; and (c) after cleaning, the fluorescent Product will **maintain daytime luminance equal to or greater than the minimums specified in Table A.**

Table D – Warranty Period for Fluorescent Colors.

Color	Warranty Period
Fluorescent Yellow	10/7 Years[5]
Fluorescent Yellow Green	10/7 Years[5]
Fluorescent Orange	3 Years

[5] Due to climatic conditions, Signs in Alabama, Arizona, Florida, Georgia, Hawaii, Louisiana, Mississippi, New Mexico, South Carolina and Texas have the 7-year Additional Warranty Period.

2. If a Sign made with Fluorescent Product is proven not to have met the Additional Warranty, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option:

(a) for those Fluorescent Products with a 10-year Additional Warranty Period, 3M will, at its expense: (a) restore the Sign's surface to its **original effectiveness** if this occurs within seven years after the Fabrication Date; or (b) furnish only the necessary 3M Fluorescent Product and matched component materials quantity to restore the Sign's surface to its original effectiveness if this occurs during the remainder of the Warranty Period.

(b) for those Fluorescent Products with a 7-year Additional Warranty Period, 3M will, at its expense: (a) restore the Sign's surface to its **original effectiveness** if this occurs within five years after the Fabrication Date; or (b) furnish only the necessary 3M Fluorescent Product and matched component materials quantity to restore the Sign's surface to its original effectiveness if this occurs during the remainder of the Warranty Period.

(c) for those Fluorescent Products with a 3-year Additional Warranty Period, 3M will furnish only the necessary Fluorescent Product and matched component materials quantity to restore the Sign's surface to its original effectiveness.

Table E. Matched Component Materials.

Matched Components	
Process Colors	Series 880I
Process Colors	Series 880N
Thermal Transfer Ribbons – Spot Traffic Colors only*	Series TTR2300
ElectroCut™ Film	Series 1170
Premium Protective Overlay Film	Series 1160
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

* Must be covered with 3M™ ElectroCut™ Film 1170

Refer to 3M Information Folders and Product Bulletins for detailed information about recommended application procedures and equipment.

Other Product Information

Always confirm that you have the most current version of the applicable Product Bulletin, Information Folder or Other Product Information.

IF 1.4 Instructions for Interstate Squeeze Roll Applicator

IF 1.5 Hand Application Instructions

IF 1.6 Hand Squeeze Roll Applicator

IF 1.7 Sign Base Surface Preparation

IF 1.8 Process Color Application Instructions

IF 1.10 Cutting, Premasking, and Prespacing

IF 1.11 Sign Maintenance Management

PB 880I Process Color 880I

PB 880N Process Color 880N

PB 1170 ElectroCut™ Film

PB TTR2300 Thermal Transfer Ribbons Series TTR2300

PB 1160 Protective Overlay Film 1160

Limitation of Liability

3M WILL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO A BUYER FOR DIRECT (other than the applicable Limited Remedy stated above), SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS) IN ANY WAY RELATED TO A PRODUCT OR THIS PRODUCT BULLETIN, REGARDLESS OF THE LEGAL OR EQUITABLE THEORY ON WHICH SUCH DAMAGES ARE SOUGHT.

ASTM Test Methods are available from ASTM International, West Conshohoken, PA.

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Bolger 12010104
Electronic Only

3M ElectroCut™ Film

Series 1170

Product Bulletin 1170 **July 2007**

Replaces PB 1170 dated January 2004

Description

3M™ ElectroCut™ Film Series 1170 is a durable, transparent, acrylic colored film coated with a transparent, pressure-sensitive adhesive that is protected by a removable liner available in the following colors.

Color	Product Code
Yellow	1171
Red	1172
Orange	1174
Blue	1175
Standard Green (Worboy)	1176
Green	1177
Black (Opaque)	1178
Brown	1179

Series 1170 is intended for use on 3M Reflective Sheeting as part of 3M's Matched Component System™ for signing. Series 1170 E.C. Film has a clear pressure-sensitive adhesive compatible with all the following 3M reflective sheetings used in permanent signing:

3M™ Reflective Sheeting

Engineer Grade Series 3290
High Intensity Grade Series 3870
High Intensity Prismatic Series 3930
Diamond Grade™ Series 3990 VIP
Diamond Grade™ Series 3970 LDP
Diamond Grade™ Series 3990T Translucent
Diamond Grade™ DG³ Series 4000

E.C. Film is designed with a special film liner for kiss-cutting on electronic cutting machines. Rolls are available prepunched for sprocket fed cutters or unpunched for flatbed or friction fed cutters. Colored E.C. Film is often used instead of silk screened inks to provide transparent colored background copy for retroreflective street name signs and other traffic control signs. Various film widths are available to fabricate single sign panels up to 48" wide. For single panel signs requiring more than a single piece of sheeting or for multipanel signs such as guide signs, be sure to follow 3M color matching procedures in Information Folder 1.10 to achieve satisfactory results. **(For best color uniformity on a colored multipanel sign, make all panels from the same lot of E.C. Film.)**

Properties

Standard colors of series 1170 E.C. Films conform to appropriate retroreflective sheeting specifications – Federal Specification FP-96, Section 178.01 (a) and ASTM D4956 when applied over 3M™ Diamond Grade™ Reflective Sheeting Series 3970, 3990, 3990T or 4000, 3M™ High Intensity Grade Sheeting Series 3870 or 3930, or 3M™ Engineer Grade Sheeting Series 3290.

Due to the high transparency of 3M acrylic E.C. Films, retroreflective signs made with these E.C. Films give equal or better retroreflective performance than sheetings screened with transparent inks. Transparent blue, green, red, and yellow E.C. Films applied to white 3M™ Reflective Sheeting can be expected to give performance comparable to integrally colored reflective sheetings. The coefficient of retroreflection of the colored areas of E.C. Film signs will depend on both the overlay film transparency and the brightness of the white reflective substrate.

Table 1 gives the minimum and maximum coefficient of retroreflection (R_A values) for each transparent 1170 Series film as a percentage of the R_A of the white reflective background on which it is applied.

Table 1

Coefficient of retroreflection R_A* for colored E.C. Films applied over white retroreflective sheeting (expressed as % of white retroreflective sheeting background)

Transparent (R_A color/R_A white background) x 100%

Color	Minimum	Maximum
Green	13.0	20
Blue	6.5	20
Red	14.0	24
Yellow	60.0	80
Orange	30.0	-
Brown	5.0	-
Standard Green (Worboy)**	8.0	14

*RA (cd/lux/m^2) measurments shall be made at 0.2° observation angle, -4° entrance angle, and 0° rotation, per ASTM E-810.

**Standard green color for U.K., Australia, and New Zealand

Film Liner

Series 1170 films have a transparent film release liner designed to aid the cutting process and the removal of the film weed after cutting. The rolls of film come edge weeded on punched rolls to prevent adhesive build-up on sprocket fed cutters.

Storage

Store in a cool, dry area 65-75˚F (18-24˚C), 30-50% relative humidity, and use within one year from date of receipt.

Fabrication – Cutting and Application Procedures

Important Note: It is recommended that inside radius corner fonts be used when cutting series 1170 film. Read and follow the manufacturer's operating manual carefully for proper use of cutting equipment.

1. Adjust knife pressure to cut cleanly through the film without cutting into the liner. A 30 degree blade works best. Spacing between letters or numbers should be adjusted to the aesthetic preference of the user. Consult the operating manual for instructions on how to regulate spacing. **Note:** Do not cut at high speed on variable speed machines.
2. Avoid sharp bends when cutting and handling film as this may cause film to release from the liner.
3. After cutting is complete, lay sheets flat, face to face, back to back. Always store sheets in this manner until the sheeting has been weeded and transfer tape has been applied to sheeting.
4. Use a stripping tool designed for weeding films that has a blunt (not a sharp) edge.
5. After weeding is completed, store sheets flat, face to face and back to back, until transfer tape is applied.
6. TPM-5 Clear Transfer Tape is recommended for best results. SCPM-3 Application Tape is also satisfactory for use on small signs. Other transfer tapes are not recommended.
7. Transfer tape can be applied either by hand using a plastic squeegee or through a hand squeeze roll laminator. If applying the transfer tape by hand, care must be taken to **always** squeegee from the center to the outside in both directions. If applying the transfer tape through the HSRA, the “lead” edge must be cut square and fed into the nip very carefully to avoid wrinkles in the E.C. Film.
8. Series 1170 film may be applied to the sheeting either before or after the sheeting has been applied to the substrate. Series 1170 film can be applied to Engineer Grade sheeting series 3290, High Intensity Grade sheeting series 3870 and 3930, Diamond Grade™ sheeting series 3970, 3990, 3990T and 4000. Use of a hand squeeze roll laminator is recommended to ensure satisfactory results. Use the “split liner method” – start in the middle of the sheet and remove half the liner to ensure proper alignment.
9. After series 1170 film and sheeting have been applied, remove the transfer tape by carefully removing the tape at as low an angle as possible.
10. IMPORTANT! When the transfer tape has been removed, reroll the sign through the laminator to ensure good adhesion.
11. A clean cutting blade is required. To remove adhesive build-up use a soft cloth dampened with mineral spirits, isopropyl alcohol or 3M Natural Cleaner.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

General Performance Considerations

All existing field performance warranties for the reflective sheetings remain in effect when series 1170 film is applied over recommended Reflective Sheetings.

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Engineer Grade Prismatic Reflective Sheeting

Series 3430 with Pressure Sensitive Adhesive

Product Bulletin 3430-U.S. **October 2013**

Replaces Product Bulletin 3430 dated July 2009

Description

3M™ Engineer Grade Prismatic Reflective Sheeting Series 3430 is a non-metalized microprismatic lens retroreflective sheeting designed for production of reflective commercial signs and noncritical traffic control signs that are exposed vertically in service. Series 3430 sheeting can easily be identified by the visible integral "EGP" marking. When applied to properly prepared sign substrates, Series 3430 sheeting provides long-term reflectivity and durability. Series 3430 sheeting is available in the following colors.

Color	Product Code
White	3430
Yellow	3431
Red	3432
Blue	3435
Green	3437
Brown	3439

Sign Fabrication Methods

Application

Series 3430 sheeting incorporates a pressure sensitive adhesive and should be applied to the sign substrate at temperature of 65°F/18°C or higher by any of the following methods:

Mechanical squeeze roll applicator – Reference Information Folder 1.4.

Hand squeeze roll applicator — Reference Information Folder 1.6.

Hand application is recommended for copy only. See Information Folder 1.5.

All direct applied copy and border MUST be cut at all panel seams and squeegeed at the joint.

Splices

Series 3430 sheeting must be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other. This is to prevent buckling as the sheeting expands when subject to extreme temperature and/or high humidity levels.

Double Faced Signs

The sheeting on the bottom side of a double faced sign can be damaged if rolled through a squeeze roll applicator with an unprotected steel bottom roller. The use of a semi-soft flat sheet between the steel roller and the applied sign face will provide protection from damage. A material such as a rubber mat, tag board or cardboard is recommended.

Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extrusions. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

- Clean
- Smooth
- Flat
- Rigid
- Dimensionally stable
- Weather resistant
- Non-porous
- High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy may require additional preparation such as flame treatment, mechanical abrasion or use of adhesion promoters prior to sheeting application.

Engineer grade prismatic sheeting is designed primarily for applications to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is required. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.**

Screen Processing

Engineer grade prismatic sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M™ Process Colors Series 880I or Series 880N. Series 880I or 880N process colors can be screened at 60–100ºF (16–38ºC) at relative humidity of 20–50%. A PE 157 screen mesh with a fill pass is recommended. Refer to Information Folder 1.8 for details. Clear coating is not required or recommended. Use of other process colors series is not recommended. **Care should be taken to avoid flexing series 3430 sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.**

For screenprinted areas on white sheeting when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 70% of the value for the corresponding color in Table A. The color chromaticity and luminance shall conform to Table B.

Cutting and Matching

Engineer grade prismatic sheeting may be cut into letters and shapes of at least three inches in height and stroke widths of at least one half inch. Smaller sizes are not recommended. Sealing cut edges of Series 3430 sheeting is not required.

Plotter Cutting

Programmable knife cut (electronic cutting)

1. Flat bed plotters can either die cut or kiss cut and offer the most consistent and reliable performance.
2. Friction fed plotter. Kiss cut only. Success has been achieved using plotters that have 600 grams of down force and a 60º cutting blade. Additional drive wheels may need to be added to improve tracking. An alternative procedure is to cut sheeting from the liner side. Blade force and knife depth must be set to score but not cut through the topfilm. Break apart individual copy or apply premask to retain spacing.

Other Cutting Methods

Engineer grade prismatic sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Cutting equipment such as guillotines and metal shears, which have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting series 3430 sheeting is one and a half inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

Cleaning	Signs that require cleaning should be flushed with water, then washed with a detergent solution and a soft bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. See Information Folder 1.10.
Storage and Packaging	3M™ Engineer Grade Prismatic Sheeting should be stored in a cool, dry area, preferably at 65–75ºF (18–24ºC) and 30–50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge. Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheet against the sign face. Double faced signs must have the glossy side of the slipsheet against each face of the sign. Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face. Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges. Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.
Installation	Nylon washers are required when twist style fasteners are used to mount the sign.
Health and Safety Information	Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.
General Performance Considerations	Minimum coefficient of retroreflection, chromaticity limits, and daytime luminance factor (Y%) for the engineer grade prismatic sheeting series 3430 are given in Table A and Table B, respectively. **Durability Considerations** The durability of 3M™ Engineer Grade Prismatic Sheeting and finished signs using 3M's matched component materials (Table C) will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Maximum durability of series 3430 can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations. Periodic sign inspection and regular sign replacement are strongly recommended in order for sign owners to establish their own effective service life expectation beyond any durability warranty, if provided. **Substrate Considerations** The user must determine the suitability of any nonmetallic sign backing for its intended use. Substrate manufacturer recommendations for preparation should be followed as well as guidance provided in Information Folder 1.7. Applications to unprimed, excessively rough or non-weather resistant surfaces can shorten the performance of such applications. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.** **Exposure Considerations** Exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability. **Custom Process Colors Considerations** Custom colors, certain lighter colors, heavily toned color or blends containing yellow or gold may have reduced durability.

General Performance Considerations (Continued)

Table A — Minimum Coefficient of Retroreflection
Candelas/Foot Candle/Square Foot
Candelas/Lux/Square Meter

Obs. Angle[1]	Ent. Angle[2]	White	Yellow	Red	Green	Blue	Brown
0.2	-4	70	50	14.5	9.0	4.0	2.0
0.2	+30	30	22	6.0	3.5	1.7	1.0
0.5	-4	30	25	7.5	4.5	2.0	1.0
0.5	+30	15	13	3.0	2.2	0.8	0.5

Reflectivity conforms to ASTM D 4956.

[1]Observation Angle — The angle between the illumination axis and the observation axis.

[2]Entrance Angle — The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Table B — CIE Chromaticity Coordinate Limits

Color	x	y	x	y	x	y	x	y	Reflectance Limit (Y)	
									Min	Max
White	.303	.300	.368	.366	.340	.393	.274	.329	27.0	
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	15.0	45.0
Red	.648	.351	.735	.265	.629	.281	.565	.346	2.5	12.0
Blue	.140	.035	.244	.210	.190	.255	.065	.216	1.0	10.0
Green	.026	.399	.166	.364	.286	.446	.207	.771	3.5	9.0
Brown	.430	.340	.610	.390	.550	.450	.430	.390	4.0	9.0

Table C — Matched Component Materials

Matched Components	
Process Colors	Series 880I
Process Colors	Series 880N
Premium Protective Overlay Film	Series 1160
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

3M Basic Warranty and Limited Remedy

3M™ Engineer Grade Prismatic Reflective Sheeting Series 3430 (“Product”) is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If the product is proven not to have met the Basic Warranty on its shipment date, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, will be refund or replacement of the sheeting.

Limitation of Liability and Remedies

3M WILL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO A BUYER FOR DIRECT (other than the applicable Limited Remedy stated above), SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS) IN ANY WAY RELATED TO A PRODUCT OR THIS PRODUCT BULLETIN, REGARDLESS OF THE LEGAL OR EQUITABLE THEORY ON WHICH SUCH DAMAGES ARE SOUGHT.

Literature Reference	Information Folder 1.4	Instructions for Squeeze Roll Applicator
	Product Bulletin 880I	3M™ Process Color Series 880I
	Product Bulletin 880N	3M™ Process Color Series 880N
	Information Folder 1.5	Hand Application Instructions
	Information Folder 1.6	Instructions for Hand Squeeze Roll Applicator
	Information Folder 1.7	Sign Base Surface Preparation
	Information Folder 1.8	Process Color Instructions
	Information Folder 1.10	Cutting, Matching, Premasking, and Prespacing Instructions
	Information Folder 1.11	Sign Maintenance Management

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Science.
Applied to Life.™

Traffic Safety and Security Division

3M™ Advanced Engineer Grade Prismatic Sheeting

Series 7930 with Pressure Sensitive Adhesive Market Test

Product Bulletin 7930
July 2015

Description

3M™ Advanced Engineer Grade Prismatic Sheeting Series 7930 meets ASTM D4956 Type I and is a non-metalized microprismatic reflective sheeting designed for production of reflective commercial signs and non-critical traffic control signs that are exposed vertically in service, as well as pressure sensitive stickers. Unique micro-sealing technology gives Series 7930 a more uniform visual appearance compared to other prismatic products and a whiter base color compared to beaded sheeting. Series 7930 can be readily identified by the integral product number watermark. When applied to properly prepared sign substrates, Series 7930 sheeting provides long-term reflectivity and durability.

Series 7930 sheeting is available in the following colors.

Color	Product Code
White	7930
Yellow	7931
Red	7932
Orange	7934
Blue	7935
Green	7937
Brown	7939

Sign Fabrication Methods

Application

Series 7930 sheeting incorporates a pressure sensitive adhesive and should be applied to the sign substrate at room temperature 65°F (18°C) or higher by any of the methods below. If the sheeting temperature is less than 65°F (18°C), allow it to condition to 65°F – 75°F (18°C – 24°C) for at least 24 hours.

Mechanical squeeze roll applicator – Reference Information Folder 1.4.

Hand squeeze roll applicator — Reference Information Folder 1.6.

Hand application is recommended for copy only. See Information Folder 1.5. Hand applications may result in visual irregularities that may be aesthetically objectionable to some customers. Such irregularities are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.
All direct applied copy and border MUST be cut at all panel seams and squeegeed at the joint.

Splices

Series 7930 sheeting should be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other at the splice. This is to prevent buckling as the sheeting expands in extreme temperature/humidity exposure.

Double Faced Signs

The sheeting on the bottom side of a double faced sign can be damaged if rolled through a squeeze roll applicator with an unprotected steel bottom roller. The use of a semi-soft flat sheet between the steel roller and the applied sign face will provide protection from damage. A material such as a rubber mat, tag board or cardboard is recommended

Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extruded aluminum street name blades. It is up to the individual customer to determine if a substrate is appropriate for its specific purpose. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

- Clean
- Smooth
- Flat
- Rigid
- Dimensionally stable
- Weather resistant
- Non-porous
- High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy may require additional preparation such as flame treatment, mechanical abrasion or use of adhesion promoters prior to sheeting application.

Series 7930 is designed primarily for applications to flat substrates but also may be suitable for simple curves, such as a pipe. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is required. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's application.

Imaging

Screen Processing

Series 7930 may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M™ Process Colors Series 880N or Series 880I. Series 880N and Series 880I process colors can be screened at 60–100°F (16–38°C) at relative humidity of 20–50%. A PE 157 screen mesh with a fill pass is recommended. Refer to Information Folder 1.8 for details. Clear coating is not required or recommended. Use of other process colors series is not recommended. **Care should be taken to avoid flexing Series 7930 sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.**

For screen printed areas on white sheeting when processed according to 3M recommendations, the coefficients of retroreflection should not be less than 70% of the value for the corresponding color in Table A. The color chromaticity and luminance shall conform to Table B.

Digital Printing

Series 7930 may be appropriate for UV ink jet and latex printing. Due to high variations in the available UV ink jet and latex printing systems and inks, individual equipment and applications should be evaluated by the customer for suitability and for identifying optimal settings.

Series 7930 is not recommended for thermal transfer printing.

Cutting and Matching

Series 7930 may be cut into letters and shapes for direct applied copy. Sealing cut edges of Series 7930 sheeting is not required.

Plotter Cutting

Users are encouraged to evaluate cutting procedures for their own equipment and shop conditions, using typical commercial vinyl settings. A slight increase in down force and knife depth may be needed.

Premasking/Prespacing

1. Premasked Markings: Use Application Tape SCPM-3.
2. Prespaced Markings: Use Prespacing Tape SCPS-2 or Application Tape SCPM-3.

Other Cutting Methods

Series 7930 may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Cutting equipment such as guillotines and metal shears, which have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting Series 7930 sheeting is 50 sheets. Details on cutting can be found in Information Folder 1.10.

Background matching
When used as background, sheeting should be oriented identically across all panels or pieces of the sign for uniform appearance of sign background.

Fabrication Lines
The manufacture of prismatic sheeting results in lines being present in the product. Series 7930 fabrication lines may be noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 1).

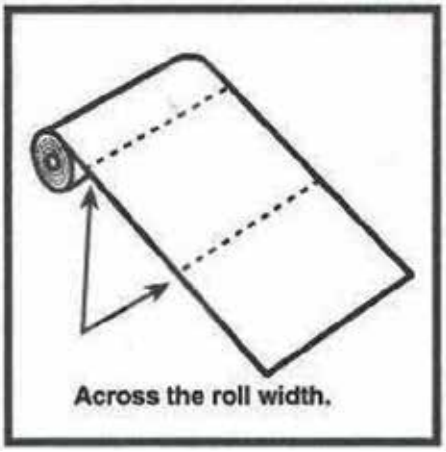

Figure 1 - Fabrication Lines

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. See 3M Information Folder 1.10.

Storage and Packaging

Series 7930 should be stored in a cool, dry area, preferably at 65–75°F (18–24°C) and 30–50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge. Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheet against the sign face. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are required when twist style fasteners are used to mount the sign.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.

General Performance Considerations

Minimum coefficient of retroreflection, chromaticity limits, and daytime luminance factor (Y%) for the engineer grade prismatic sheeting Series 7930 are given in Table A and Table B, respectively.

Durability Considerations

The durability of Series 7930 and finished signs using 3M's matched component materials (Table C) will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Advanced engineer grade prismatic reflective sheeting can be expected to provide satisfactory performance for five to seven years when processed with 3M matched component inks and films, depending upon climatic conditions of the installation.

Maximum durability of Series 7930 can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations. Periodic sign inspection and regular sign replacement are strongly recommended in order for sign owners to establish their own effective service life expectation beyond any durability warranty, if provided.

Substrate Considerations

The user must determine the suitability of any nonmetallic sign backing for its intended use. Substrate manufacturer recommendations for preparation should be followed as well as guidance provided in Information Folder 1.7. Applications to unprimed, excessively rough or non-weather resistant surfaces can shorten the performance of such applications. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.**

Exposure Considerations

Exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability.

Custom Process Colors Considerations

Custom colors, certain lighter colors, heavily toned color or blends containing yellow or gold may have reduced durability. Digitally printing signs may have reduced durability and may fail to meet the color and brightness requirements of the regulated traffic sign markets.

Minimum coefficient of retroreflection, chromaticity limits, and daytime luminance factor (Y%) for Series 7930 are given in Table A and Table B, respectively.

General Performance Considerations (continued)

Table A – Minimum Coefficient of Retroreflection

Candelas/Foot Candle/Square Foot Candelas/Lux/Square Meter

Obs.[1] Angle	Ent Angle[2]	White	Yellow	Red	Orange	Green	Blue	Brown
0.2	-4	70	50	14.0	25	9.0	4.0	1.0
0.2	+30	30	22	6.0	7.0	3.5	1.7	0.3
0.5	-4	30	25	7.5	13	4.5	2.0	0.3
0.5	+30	15	13	3.0	4.0	2.2	0.8	0.2

Reflectivity conforms to ASTM D 4956-13.
[1]Observation Angle – The angle between the illumination axis and the observation axis.
[2]Entrance Angle – The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Table B – CIE Chromaticity Coordinate Limits

									Reflectance Limit (Y)	
Color	x	y	x	y	x	y	x	y	Min	Max
White	.303	.300	.368	.366	.340	.393	.274	.329	27.0	
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	15.0	45.0
Red	.648	.351	.735	.265	.629	.281	.565	.346	2.5	15.0
Orange	.558	.352	.636	.364	.570	.429	.506	.404	10.0	30.0
Blue	.140	.035	.244	.210	.190	.255	.065	.216	1.0	10.0
Green	.026	.399	.166	.364	.286	.446	.207	.771	3.0	12.0
Brown	.430	.340	.610	.390	.550	.450	.430	.390	1.0	9.0

Table C – Matched Component Materials

Matched Components	
Process Color	Series 880N or Series 880I
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

Additional General Performance Considerations - Orange

Advanced Engineer Grade Prismatic Sheeting Orange 7934 can be expected to provide satisfactory performance for up to three years when processed with 3M matched component inks and films, depending upon climatic conditions of the installation. The user must determine the suitability of any sign substrate for its intended use. Applications to unprimed, excessively rough or non-weather-resistant surfaces, or exposure to severe or unusual conditions can shorten the durability of such applications.

3M Basic Warranty and Limited Remedy

3M Advanced Engineer Grade Prismatic Sheeting Series 7930 (“Product”) is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If the product is proven not to have met the Basic Warranty on its shipment date, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, will be refund or replacement of the sheeting.

Limitation of Liability and Remedies

3M WILL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO A BUYER FOR DIRECT (other than the applicable Limited Remedy stated above), SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS) IN ANY WAY RELATED TO A PRODUCT OR THIS PRODUCT BULLETIN, REGARDLESS OF THE LEGAL OR EQUITABLE THEORY ON WHICH SUCH DAMAGES ARE SOUGHT.

Literature Reference

Product Bulletin 880I	3M™ Process Color Series 880I
Product Bulletin 880N	3M™ Process Color Series 880N
Information Folder 1.4	Instructions for Squeeze Roll Applicator
Information Folder 1.5	Hand Application Instructions
Information Folder 1.6	Instructions for Hand Squeeze Roll Applicator
Information Folder 1.7	Sign Base Surface Preparation
Information Folder 1.8	Process Color Instructions
Information Folder 1.10	Cutting, Matching, Premasking, and Prespacing Instructions
Information Folder 1.11	Sign Maintenance Management

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All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Flexible Prismatic Reflective Sheeting

Series 3300 With Pressure Sensitive Adhesive

For Use on Reboundable Plastic Traffic Control Devices

Product Bulletin 3300 **May 2014**

Replaces PB 3300 Dated July 2011

Description

3M™ Flexible Prismatic Reflective Sheeting Series 3300 is intended for reflectorizing rigid or reboundable traffic control devices such as drums, barricades and channelizers. Series 3300 consists of impact resistant prismatic lens reflective sheeting precoated with pressure sensitive adhesive and exceeds the reflectivity values of ASTM Type III.

Table I — Series 3300 is available in the following colors

Product Number	Color
3310	White
3311	Yellow
3312	Red
3314	Orange

Photometric

Daytime Color (x,y,Y)

The chromaticity coordinates and luminance factor of the retroreflective sheeting conform to Table II.

Color Test – Ordinary Color

Conformance to standard chromaticity (x,y) and luminance factor (Y %) requirements should be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values should be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations will be done for CIE Illuminant D65 and the 2° standard observer.[1]

[1]The instrumentally determined color values of retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the Color Specification of Fluorescent Retroreflective Materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer should be the referee instrument.

Photometric (continued)

Table II — CIE Chromaticity Coordinate Limits[2] for new sheeting

	1		2		3		4		Limit Y (%)	
Color	x	y	x	y	x	y	x	y	Min.	Max
White	.303	.300	.368	.366	.340	.393	.274	.329	27	–
Orange	.558	.352	.636	.364	.570	.429	.506	.404	14	30
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	15	45
Red	.648	.351	.735	.265	.629	.281	.565	.346	2.5	15

[2]The four pairs of chromaticity coordinates define the acceptable color in terms of the CIE 1931 standard colormetric system measured with standard illuminant D64.

Coefficients of Retroreflection (R_A)

The value in Table III are minimum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m2).

Test for Coefficients of Retroreflection

Conformance to coefficient of retroreflection requirements are determined by instrumented test method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection Sheeting"

Table III
Minimum Coefficient of Retroreflection R_A Candelas per Foot Candle per Square Foot or Candelas per Lux per Square Meter (Average 0º and 90˚ Rotation)

3310 White

Observation Angle[3]	Entrance Angle	
	-4°	30°
0.1	300	180
0.2	250	150
0.5	95	65

3314 Orange

Observation Angle[3]	Entrance Angle	
	-4°	30°
0.1	120	72
0.2	100	60
0.5	30	25

3311 Yellow

Observation Angle[3]	Entrance Angle	
	-4°	30°
0.1	200	120
0.2	170	100
0.5	62	45

3312 Red

Observation Angle[3]	Entrance Angle	
	-4°	30°
0.1	54	32
0.2	45	25
0.5	15	10

[3]Observation Angle — The angle between the illumination axis and the observation axis.

Recommended Substrates & Application Procedures

Series 3300 is designed for application to clean polyethylene-based work zone devices such as drums, tubes, and posts. Series 3300 sheeting is designed for use on clean, smooth, relatively non-porous, weather resistant surfaces when prepared as detailed in Information Folder 1.7. Series 3300 sheeting may be applied using a squeeze roll applicator or by hand. The application temperature (and substrate temperature) should exceed 60˚F. If hand applied, sheeting should be applied with firm pressure using a plastic squeegee or rubber roller. Without endorsement of the use of such substrates, some comments regarding their use can be made. The polyethylene substrate must be properly flame-treated or corona treated before sheeting application (see Information Folder 3.3 for substrate preparation).

Plastics, including fiberglass laminates, vary as to type, composition, and manufacture, so that their use as an application surface requires careful evaluation under actual use conditions. Some plastics embrittle on exposure and some plastics contain migrating constituents that may contaminate the adhesive or cause sheeting discoloration and adversely affect performance. Also, some plastics are affected by ingredients in the sheeting adhesives that migrate into the panel. 3M Information Folder 1.7 may provide further insight into applications on plastic substrates.

Note: Care must be exercised to avoid stretching material when aligning during application. This sheeting has sufficient elongation to permit its flexing on reboundable plastic devices when impacted. However, if it is stretched during application, this feature will be significantly reduced and cracking may result.

Adhesive and Film Properties

Standard Test Panels

Unless otherwise specified herein, sheeting should be applied to test panels and conditioned in accordance with ASTM D4956 and test methods and conditions should conform to ASTM D4956.

Properties

The following properties should conform to the requirements in ASTM D4956.

1. Adhesion
2. Outdoor weathering
   – retained coefficient of retroreflection
   – colorfastness
3. Shrinkage
4. Flexibility
5. Liner removal
6. Impact resistance
7. Night time color

In addition, Series 3300 sheeting will conform to the following properties.

1. Gloss
   Test Method — Test in accordance with ASTM D523 using a 60° glossmeter.
   Requirement — Rating not less than 50.
2. Optical Stability
   Test Method — Apply a 3 inch x 6 inch sample to a test panel. Measure R_A then place it in an oven at 71°C ± 3°C (160°F ± 5°F) for 24 hours followed by conditioning at standard conditions for two hours.
   Remeasure R_A.
   Requirement — The sheeting will retain a minimum of 85% and a maximum of 115% of the original coefficient of retroreflection.

Cleaning

Sheeting that requires cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the materials. Flush with water following washing. Do not use solvents to clean sheeting. See Information Folder 1.10.

Storage and Packaging	Series 3300 sheeting should be stored in a cool, dry area, preferably at 65-75°F (18-24°C) and 30-50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Devices such as drums should be stored or shipped vertically stacked to avoid scuffing during shipment.
Health and Safety Information	Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.
General Performance Considerations	The durability of Series 3300 depends upon many factors including, but not limited to, substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. The user must determine the suitability of this material on any specific substrate or device for its intended use. Applications on improperly prepared, excessively rough or non-weather resistant surfaces, or exposure to severe or unusual conditions can reduce the durability of such applications. Purchaser should select a suitable test for determining reflective sheeting performance on any device or substrate. For reboundable substrates, the test should include plastic manufacturer's recommendation for impacting reboundable plastic traffic control devices.
3M Basic Product Warranty and Limited Remedy	3M™ Flexible Prismatic Reflective Sheeting Series 3300 ("Product") is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If the Product is proven not to have met the Basic Warranty on its shipment date, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option, will be refund or replacement of the Product.
Limitation of Liability and Remedies	3M's liability under this warranty is limited to replacement or allowance as stated herein, and 3M assumes no liability for incidental or consequential damages such as lost profits, business or revenue in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR PERFORMANCE, CUSTOM OR USAGE OF TRADE.
Literature Reference	Information Folder 1.5 Hand Application Instructions Information Folder 1.6 Hand Squeeze Roll Applicator Information Folder 1.7 Sign Base Surface Preparation Information Folder 1.8 Process Color Instructions Information Folder 1.10 Cutting, Premasking, and Prespacing Instructions Information Folder 1.11 Reflective Sheeting Sign Maintenance Management

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High Intensity Prismatic Reflective Sheeting Series 3930

Product Bulletin 3930 **January 2013**

Replaces PB 3930 dated January 2012

Description

3M™ High Intensity Prismatic Reflective Sheeting Series 3930 is a non-metalized microprismatic lens reflective sheeting designed for production of reflective durable traffic control signs, work zone devices and delineators that are exposed vertically in service. Applied to properly prepared sign substrates, 3M high intensity prismatic sheeting provides long-term reflectivity and durability. Series 3930 sheeting is available in the following colors.

Color	Product Code
White	3930
Yellow	3931
Red	3932
Orange	3934
Blue	3935
Green	3937
Brown	3939
Color – TT Series	
White – thermal transfer (TT) printable	3930TT
Yellow – TT printable	3931TT

Photometrics

Daytime Color (x,y,Y)

The chromaticity coordinates and total luminance factor of the retroreflective sheeting conform to Table A.

Color Test – Ordinary Colored Sheeting

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.[2]

[2]The instrumentally determined color values of retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the Color Specification of Fluorescent Retroreflective Materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer shall be the referee instrument.

Coefficients of Retroreflection (R_A)

The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per squaremeter (cd/lux/m²).

Table A Daytime color specification limits[1]

Color	x	y	x	y	x	y	x	y	Daytime Luminance Limit Min.	Max.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	27	
Yellow	0.498	0.412	0.557	0.422	0.479	0.520	0.438	0.472	15	45
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	15
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	10	30
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	3	12
Brown	0.430	0.340	0.610	.0390	0.550	0.450	0.430	0.390	1	9

[1]The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colormetric System.

Test for Coefficients of Retroreflection

Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection of Retroreflective Sheeting", and per E-810 the values of 0º and 90º rotation are averaged to determine the R_A in Table B.

Table B

Minimum Coefficient of Retroreflection R_A for new fluorescent sheeting(cd/lux/m^2)

-4º Entrance Angle[3]	Observation Angle[4]	
	0.2º	0.5º
White	560	200
Yellow	420	150
Red	84	30
Orange	210	75
Green	56	21
Blue	30	13
Brown	18	7.5
30º Entrance Angle[3]		
White	280	100
Yellow	210	75
Red	42	15
Orange	105	37
Green	28	10
Blue	14	6
Brown	8.5	3.5

[3]Entrance Angle – The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

[4]Observation Angle – The angle between the illumination axis and the observation axis.

Printed Colors and Overlay Films

For screenprinted or thermally transfer printed transparent color areas on white sheeting when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 70% of the value for the corresponding color in Table B. For white sheeting covered with 3M™ ElectroCut™ Film Series 1170 when processed according to 3M recommendations, the coefficients of retroreflection shall not be less than 100% of the value for the corresponding color in Table B. The color chromaticity and luminance shall conform to Table A on page 1.

Entrance Angularity Performance in Regard to Orientation

High intensity prismatic reflective sheeting is designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or ultimate orientation of the sign after installation. Signs and applied copy (letters, arrows, borders and shields) can be fabricated and installed using the application orientation that most efficiently utilizes the reflective sheeting.

Note: *For multi-panel signs it is recommended that all background panels be sheeted such that the sheeting direction is the same for all panels.*

Fabrication Lines

The manufacture of prismatic sheeting results in lines being present in the product. In high intensity prismatic sheeting these lines are slightly thicker than the seal pattern legs. Fabrication lines are noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 1).

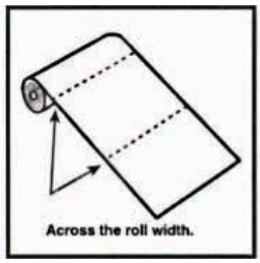

Figure 1 – Fabrication Lines

Adhesive

Series 3930 sheeting has a pressure-sensitive adhesive that is recommended for application at temperatures of 65ºF (18ºC) or higher.

Adhesive and Film Properties

Standard Test Panels

Unless otherwise specified herein, sheeting shall be applied to test panels and conditioned in accordance with ASTM D4956 and test methods and conditions shall conform to ASTM D4956.

Properties

The following properties shall conform to the requirements in ASTM D4956.

1. Adhesion
2. Outdoor weathering
   - retained coefficient of retroreflection
   - colorfastness

3. Shrinkage
4. Flexibility
5. Liner removal
6. Impact resistance
7. Night time color

In addition, Series 3930 sheeting will conform to the following properties.

1. Gloss
Test Method – Test in accordance with ASTM D523 using a 60º glossmeter.
Requirement – Rating not less than 50.

2. 2. Optical Stability
Test Method – Apply a 3 inch x 6 inch sample to a test panel. Measure R_A then place it in an oven at 71º C ± 3º C (160ºF ± 5ºF) for 24 hours followed by conditioning at standard conditions for 2 hours Remeasure R_A.

Requirement – The sheeting shall retain a minimum of 85% and a maximum of 115% of the original coefficient of retroreflection.

Sign Fabrication Methods

Application

Series 3930 sheeting incorporates a pressure sensitive adhesive and should be applied to the sign substrate at temperature of 65ºF/18ºC or higher by any of the following methods:

Mechanical squeeze roll applicator – refer to 3M Information Folder (IF) 1.4. Application to extrusions that are edge wrapped requires sufficient softening of the sheeting. This can be accomplished by directing additional heat to the "next to last" edge roller. This practice will increase productivity and minimize cracking.

Hand squeeze roll applicator – refer to 3M IF 1.6.

Application of Series 3930 sheeting for complete signs or backgrounds must be done with a roll laminator, either mechanical or hand driven.

Hand Application

Hand application is recommended for legend and copy only. Refer to 3M Information Folder 1.5 for more details.

Hand applications will show some visual irregularities, which are objectionable to aesthetically critical customers. These are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.

All direct applied copy and border MUST be cut at all metal joints and squeegeed at the joints.

Splices

Series 3930 sheeting must be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other. This is to prevent buckling as the sheeting expands in extreme temperature and humidity exposure.

Double Faced Signs

The sheeting on the bottom side of a double faced sign can be damaged if rolled through a squeeze roll applicator with an unprotected steel bottom roller. The use of a semi-soft flat sheet between the steel roller and the applied sign face will provide protection from damage. A material such as a rubber mat, tag board or cardboard is recommended.

Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extrusions. **Users are urged to carefully evaluate all other substrates for adhesion and sign durability.** Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

- Clean
- Smooth
- Flat
- Rigid
- Dimensionally stable
- Weather resistant
- Non-porous
- High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy may require additional preparation such as flame treatment, mechanical abrasion or use of adhesion promoters prior to sheeting application. Guide sign extrusions may be edge wrapped. Flat panels or unwrapped extrusions are to be carefully trimmed so that sheeting from adjacent panels does not touch on assembled signs.

High intensity prismatic sheeting is designed primarily for applications to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is required. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.**

Imaging

High intensity prismatic sheeting may be processed into traffic signs by any of the imaging methods described below. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or matched component imaging materials other than those listed below.

Screen Processing

Series 3930 sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I or Series 880N. Series 880I or 880N process colors can be screened at 60-100ºF (16-38ºC) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. Refer to Information Folder 1.8 for details. No clear coating is required and is not recommended. Use of other process colors series is not recommended. **Care should be taken to avoid flexing high intensity prismatic sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.**

Thermal Transfer Printing

High intensity prismatic TT series sheeting may be imaged with 3M™ Thermal Transfer Ribbon Series TTR2300 in conjunction with the Matan SprinG3 or Matan Spot4 thermal transfer printers. For regulated traffic signs, Series TTR2300 Spot Traffic Colors are to be applied using these printers and must be covered with 3M™ ElectroCut™ Film 1170. Refer to Product Bulletin TTR2300 for more information.

3M™ ElectroCut™ Film

3M™ ElectroCut™ Film Series 1170 may be used to provide transparent colored background copy for traffic control signs on high intensity prismatic sheeting. Refer to Product Bulletin 1170 for fabrication procedures.

Applied Cut-Out Copy

High intensity prismatic cut letters may be applied to series 3930 sheeting background to create a sign legend. Such cut-out copy may be directly applied to the background sheeting, or may be applied in a demountable form. Direct applied copy must be cut at all panel seams and carefully trimmed back so that sheeting from adjacent panels does not touch on assembled signs. Refer to Information Folder 1.10 for more information.

Note: *It is recommended to fabricate all but the largest signs using 1170 electronic cuttable overlay film (ECOF) instead of direct applied copy.*

Additional Imaging Options for Work Zone Signs

Vinyl Graphic Films

Scotchcal™ Vinyl Series 3650, Series 7720 and Series 7725 may be used to provide copy for traffic control signs on high intensity prismatic sheeting (typically orange, white or yellow sheeting) for use in construction work zones. Refer to Scotchcal™ product literature for more information.

Latex Ink Jet Printing

Series 3930 sheeting to be used in work zone signs may be imaged with HP 789 series black latex ink in conjunction with the HP Designjet L25500 Printer, or with 792 series black latex ink in conjunction with the HP Designjet L26500 Printer. Refer to Information Folder 3.4 for more information.

Note: *With the exception of 3M branded products, 3M does not represent that any printer or printer accessory recommended in 3M literature will meet customer requirements, any federal, state or local regulations or any applicable safety standards. Such determination is the responsibility of the printer owner.*

Cutting

Series 3930 sheeting may be cut into letters and shapes of at least 3 inches in height and stroke widths of at least 1/2 inch. Smaller sizes are not recommended. Sealing cut edges of Series 3930 sheeting is not required.

Plotter Cutting

Programmable knife cut (electronic cutting)

1. Flat bed plotters can either die cut or kiss cut and offer the most consistent reliable performance.
2. Friction Fed plotter. Kiss cut only. Success has been achieved using plotters that have 600 grams of down force and a 60º cutting blade. Additional drive wheels may need to be added to improve tracking. An alternative procedure is to cut sheeting from the liner side. Blade force and knife depth must be set to score but not cut through the topfilm. Break apart individual copy or apply premask to retain spacing.

Other Cutting Methods

Series 3930 sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Cutting equipment such as guillotines and metal shears, which have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage. Maximum stack height for cutting Series 3930 sheeting is 1 ½ inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

Storage and Packaging

Series 3930 sheeting should be stored in a cool, dry area, preferably at 65-75ºF (18-24ºC) and 30-50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the slipsheet against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are required when twist style fasteners are used to mount the sign.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. Refer to 3M Information Folder 1.10.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet and/ or product label of any materials prior to handling or use.

General Performance Considerations

The durability of high intensity prismatic Series 3930 sheeting and finished signs using 3M Matched Component materials will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Maximum durability of Series 3930 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in Information Folder 1.7. The user must determine the suitability of any nonmetallic sign backing for its intended use. **Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M**. Applications to unprimed, excessively rough or non-weather resistant surfaces or exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. 3M process colors and ElectroCut™ Film, when used according to 3M recommendations, are generally expected to provide performance comparable to colored reflective sheeting. Custom colors, certain lighter colors, heavily toned colors or blends containing yellow or gold may have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability.

Periodic sign inspection and regular sign replacement are strongly recommended in order for sign owners to establish their own effective service life expectation, beyond the warranty period.

3M has tested HP Designjet Printers and black latex inks: L25500 printer/series 789 black ink, and L26500 printer/series 792 black ink; and when applied within parameters defined in IF 3.4 the resulting sign performance is considered to be commensurate with typically expected sign life. However, this imaging system is not covered as part of the 3M Matched Component system noted in the General Warranty Terms.

3M Basic Product Warranty and Limited Remedy

3M™ High Intensity Prismatic Reflective Sheeting Series 3930 ("Product") is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If Series 3930 Sheeting is proven not to have met the Basic Warranty on its shipment date, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option, will be refund or replacement of the sheeting.

General Warranty Terms:

1. 3M makes the Additional Warranty (as defined below) as to any traffic control and guidance sign in the United States and Canada ("Sign") made with 3M™ High Intensity Prismatic Reflective Sheeting Series 3930 ("Product") and the Matched Component materials listed in Table E. Any Additional Warranty is contingent on all components involved in that Additional Warranty being stored, applied, installed, and used only as 3M recommends in its Product Bulletins and Other Product Information.
2. The Basic Warranty and any applicable Additional Warranty are collectively referred to as the "3M Warranty." EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, RIGHTS OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND THOSE ARISING FROM A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. A BUYER IS RESPONSIBLE FOR DETERMINING IF A PRODUCT IS SUITABLE FOR ITS PARTICULAR PURPOSE AND APPLICATION METHODS.
3. A Sign's failure to meet the 3M Warranty must be solely the result of the Product or the matched component materials' design or manufacturing defects. 3M has no obligation under the 3M Warranty if a sign failure is caused by: improper fabrication, handling, maintenance or installation; non-vertical applications where the Sign face is more than +/- 10% from vertical; use of any material or product not made by 3M or not included in Table E; use of application equipment not recommended by 3M; failure of sign substrate; loss of adhesion due to incompatible or improperly prepared substrate; exposure to chemicals, abrasion and other mechanical damage; snow burial or any other sign burial; collisions, vandalism or malicious mischief.
4. 3M reserves the right to determine the method of replacement, and any replacement Product will have the remainder of the original Product's unexpired 3M Warranty. Claims made under this warranty will be honored only if
   - The Sign was dated upon completion of fabrication ("Fabrication Date") using a permanent method (sticker, permanent marker or crayon, metal stamp, etc.)
   - 3M is notified of a 3M Warranty claim during any applicable Warranty Period and the owner or fabricator provides the information reasonably required by 3M to verify if a 3M Warranty is applicable.

Additional Warranty and Limited Remedy

1. The Additional Warranty for a Sign made with the Product is that the Sign will: (a) remain effective for its intended use when viewed from **a moving vehicle under normal day and night driving conditions by a driver with normal vision,** and (b) after cleaning, will meet the **minimum values for coefficient of retroreflection stated in Table C** for Table C's applicable Warranty Period measured from the Sign's Fabrication Date.

Table C

Minimum Percent Retained of Table B

Initial R_A for applicable Warranty Period for white, yellow, red, green, blue and brown

Warranty Period	Minimum Percentage R_A Retained
1-7 Years	80%
8-10 Years	70%

2. If any Sign made with the Product is proven not to have met the Additional Warranty, then a buyer's **exclusive remedy**, and 3M's sole obligation, at 3M's option:
   a. if this occurs within seven years after the Fabrication Date, then 3M will, at its expense, restore the Sign's surface to its **original effectiveness**; or
   b. if this occurs during the remainder of the Additional Warranty Period, then 3M will furnish only the necessary 3M sheeting Product and matched component materials quantity to restore the Sign's surface to its original effectiveness.

Additional Warranty & Limited Remedy for 3934 Orange Product

1. The Additional Warranty for a Sign made with 3934 orange sheeting (Orange Product) is that the Sign will: (a) **remain effective for its intended use when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision;** (b) after cleaning, will retain the coefficient of retroreflection stated in Table D for three years measured from Fabrication Date; and (c) after cleaning, the Product will **maintain daytime luminance equal to or greater than the minimums specified in Table A.**

Table D

Minimum Coefficient of Retroreflection

for 3934 Orange sheeting Product (cd/lux/m^2)

(0.2° observation and -4° entrance)

Warranty Period	Minimum R_A
Orange	80

If any Sign made with the Product is proven not to have met the Additional Warranty, then a buyer's **exclusive remedy**, and 3M's sole obligation, at 3M's option, is that 3M will provide pro-rated replacement of the 3M materials.

Table E

Matched Component Materials.

Matched Components	
Process Colors	Series 880I
Process Colors	Series 880N
Thermal Transfer Ribbons – Spot Traffic Colors only*	Series TTR2300
ElectroCut™ Film	Series 1170
Premium Protective Overlay Film	Series 1160
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

*must be covered with 3M™ ElectroCut™ Film 1170

Refer to 3M Information Folders and Product Bulletins for detailed information about recommended application procedures and equipment.

Other Product Information

Always confirm that you have the most current version of the applicable Product Bulletin, Information Folder or Other Product Information.

IF 1.4	Instructions for Interstate Squeeze Roll Applicator
IF 1.5	Hand Application Instructions
IF 1.6	Hand Squeeze Roll Applicator
IF 1.7	Sign Base Surface Preparation
IF 1.8	Process Color Application Instructions
IF 1.10	Cutting, Premasking, and Prespacing
IF 1.11	Sign Maintenance Management
PB 880I	Process Color 880I
PB 880N	Process Color 880N
PB 1170	ElectroCut™ Film
PB TTR2300	Thermal Transfer Ribbons Series TTR2300
PB 1160	Protective Overlay Film 1160 Ink Jet Imaging with HP Designjet L25500
IF 3.4	Printer and HP 789 Series latex Inks

Limitation of Liability

3M WILL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO A BUYER FOR DIRECT (other than the applicable Limited Remedy stated above), SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS) IN ANY WAY RELATED TO A PRODUCT OR THIS PRODUCT BULLETIN, REGARDLESS OF THE LEGAL OR EQUITABLE THEORY ON WHICH SUCH DAMAGES ARE SOUGHT.

ASTM Test Methods are available from ASTM International, West Conshohoken, PA.

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Product Bulletin 3650
Release K, September 2013, *(Replaces J, Nov' 09)*
See Bulletin Change Summary on last page

Scotchcal™ Graphic Film
Series 3650

For Solvent and UV Screen Printing Only

1. Product Description

A. Product Features

- 2-mil opaque film
- Available in white, black and transparent
- Pressure-sensitive adhesive
- Resists gasoline vapors and occasional petroleum spills
- Permanent film

B. Recommended Types of Graphics and End Uses

When constructed and used as described in this Bulletin, these types of graphics and end uses may be warranted by the 3M™ MCS™ Warranty. Please read the entire Bulletin for details.

- Clear, window or 2-way graphics
- Outdoor and indoor graphics and signs
- Information labels
- Commercial fleet vehicle graphics and emblems
- Small format original equipment manufacturer's decorative and identification graphics, cautionary, safety and vandal-resistant labeling

C. Performance Overview

3M tests the performance of both individual products and finished graphic constructions. This table shows the best performance expected from this product without a Warranty Period and with a Warranty Period.

For detailed graphic construction and application options along with specific Warranty Periods, please see the Warranty Information, Section 5.

Expected Performance Life. This is the estimated period of time the product should perform satisfactorily.	
Unprinted film with no graphic protection, applied to a flat vertical outdoor surface in a non-abusive environment.	10 years (opaque) 8 years (transparent) Unwarranted Period
3M™ MCS™ Warranty. This is the maximum period of time 3M will warrant the finished graphic performance.	
Printed film with the best 3M ink and graphic protection option, applied to a flat, vertical surface.	7 years Warranty Period

D. Limitations of End Uses

This 3M product is not designed or recommended for the following uses. Please contact us to discuss other options.

(1) Unsuitable End Uses for This Film

- Graphics applied to corrugated surfaces
- Graphics applied to stainless steel vehicles
- Fleet or vehicle graphics without graphic protection
- Any graphic without graphic protection that is exposed to abrasive conditions, harsh cleaners or chemicals

Note: 3M Commercial Graphics Division policy is not to support applications of clear graphic film when a driver's view is obstructed and/or where local laws prohibit its use.

(2) Light Passage Laws and Regulations

⚠ CAUTION

Some states have laws or regulations requiring minimum light passage that may limit or preclude the use of this product on vehicle windows. The user is responsible for determining and complying with all applicable standards.

(3) Important Information About Bus Applications

Film used on buses must not be applied so as to restrict the safe use of emergency window exits. See the most current version of Instruction Bulletin 5.4 for details.

2. Compatible Products

This section provides a list of products that are approved by 3M for use with the base film covered in this Bulletin, and used for the creation of a graphic that is covered by the 3M™ MCS™ Warranty. Refer to the Product and Instruction Bulletins listed in 3M Related Literature at the end of this Bulletin for more information about the compatible products.

(1) Screen Printing Inks

- 3M™ Screen Printing Ink Series 1900 *line color and four-color*
- 3M™ Screen Printing UV Ink Series 9800 *line color and four-color*

(2) Graphic Protection

- 3M™ Screen Print Gloss Clear 1920DR
- 3M™ Screen Print Low Gloss Clear 1930
- 3M™ Screen Print UV Gloss Clear 9740i
- 3M™ Screen Print Low Gloss Clear 9730UV
- 3M™ Screen Print UV Gloss Clear 9800CL
- 3M™ Screen Printing Clear VI0402

(3) OEM Inks and Clears

For OEM graphics only!

- Sericol™ Duracal™ UV Screen Print Inks
- Sericol™ Duracal™ Screen Print Clear *(approved for OEM applications only)*

To identify a Sericol inks distributor, contact FUJIFILM North America Corporation, Graphic Systems Division at http://www.fujifilmusa.com/products/graphic_arts_printing/index.html; 1101 W. Cambridge Drive, Kansas City, KS 66103; Tel: 1-800-255-4562 or 913-342-4060.

(4) Other Products

- 3M™ Edge Sealer 3950
- 3M™ Prespacing Tape SCPS-2
- 3M™ Prespacing Tape SCPS-53X
- 3M™ Premasking Tape SCPM-3
- 3M™ Premasking Tape SCPM-44X

3. Characteristics

These are typical values for unprocessed product; processing may change the values. Contact your 3M representative for a custom specification.

A. Physical Characteristics

Characteristic	Value
Material	Vinyl
Color	3650-10: White 3650-12: Black 3650-114: Clear
Thickness	**Without adhesive:** 2 mils (0.05 mm) **With adhesive:** 3 to 4 mils (0.08 to 0.10 mm)
Adhesive type	Pressure sensitive
Adhesive color	3650-10: Gray-pigmented 3650-12: Clear 3650-114: Clear
Liner	Polyethylene-coated layflat
Tensile strength *(minimum)*	5.5 pounds/inch at 73°F (0.9 kg/cm at 23°C)
Flammability	ASTM E84 test report or go to the On-line Product Catalog at 3Mgraphics.com All other test reports: call 1-800-328-3908
Safety and regulatory recognition	Tested and found to comply with UL 969 - Standard for Marking and Labeling Systems. US file MH11410.

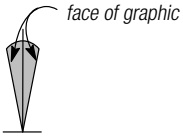
B. Application Characteristics

Characteristic	Value
Adhesion *24 hours after application*	**ABS:** 5 pounds/inch (0.9 kg/cm) **Acrylic, enamel:** 5 pounds/inch (0.9 kg/cm) **Aluminum, anodized:** 6 pounds/inch (01.1 kg/cm) **Chrome:** 5 pounds/inch (0.9 kg/cm) **Fruehauf pre-painted panels:** 4 pounds/inch (0.7 kg/cm)
Chemical resistance	Resists mild acids, mild alkalis, and salts. Excellent resistance to water *(this does not include immersion)*
Finished graphic application recommendation	**Surface type:** Flat, with and without rivets **Substrate type:** Glass, metal, paint, fiberglass reinforced plastic, rigid plastic **Application temperature:** 50° to 100°F (10° to 38° C) *air and substrate* **Application method:** Fleet & Vehicles: dry All others: wet or dry
Applied film shrinkage	0.015 inch (0.4 mm)
Finished graphic exposure temperature	-65° to +160°F (-54° to +70°C)
Graphic removal	Permanent film

4. Definitions

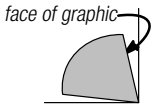
A. Exposure Types

U.S. Vertical Exposure



The face of the graphic is +/- 10° from vertical.

U.S. Non-vertical Exposure



The face of the graphic is greater than 10° from vertical and greater than 5° from horizontal. This includes non-vertical surfaces of vehicle wraps or fleet graphics.

U.S. Horizontal Exposure

The face of the graphic is +/- 5° from horizontal.

U.S. Desert Southwest Exposure

Any outdoor graphic exposed to solar energy more than half of the daylight hours in Arizona, New Mexico and the desert areas of California, Nevada, Utah and Texas is subject to reduced warranties. A detailed map is available at 3Mgraphics.com under Warranties.

B. Graphic Types

Indoor Signs

Stationary graphics applied indoors and *not* exposed to the elements.

Outdoor Signs

Stationary graphics applied outdoors and exposed to the elements.

OEM

Labels and decorative graphics produced for and used by original equipment manufacturers.

Vehicle Types

Vehicle. Buses, vans, passenger vehicles, delivery trucks, pickup trucks, enclosed trailers.

Straight Trucks, Semi-Tractors and Semi-Trailers. Straight trucks, semi-tractors and semi-trailers used for commercial business purposes. Excludes air shields.

Recreational Vehicle (RV). Vehicles used for personal pleasure, such as campers, motor homes and trailers, that are not used in connection with any commercial or business enterprise.

C. Graphic Construction

The products used to make a graphic, which may include film and/or flexible substrate, graphic protection, ink, printer and application tape.

D. Graphic Protection

Overlaminate films or clear coats used to protect the graphic and/or change gloss.

5. Warranty Information

A. Warranty Coverage Overview

The warranty coverage for each graphic is based on the user(s) both reading and following all applicable and current 3M Product and Instruction Bulletins. 3M will honor the Warranty Period stated in the base film's Product Bulletin that is current when the film was purchased. The Warranty Period may be reduced and stipulations may apply for certain constructions and applications, as covered in this Bulletin.

The following is made in lieu of all other express or implied warranties, including any implied warranty of merchantability or fitness for a particular purpose or implied warranty arising out of a course of dealing, custom or usage of trade.

B. 3M Basic Product Warranty

This product is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin and as further set forth in the 3M Commercial Graphics Warranties Brochure.

C. Limited Remedy

3M will replace or refund the price of any 3M materials that do not meet this warranty within the specified time periods. These remedies are exclusive.

D. Limitation of Liability

Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT (EXCEPT FOR THE LIMITED REMEDY PROVIDED ABOVE), INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO SELLER'S PRODUCTS, SERVICES or THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought including breach of contract, breach of warranty, negligence, strict liability, or any other legal or equitable theory.

E. Additional Limitations

See the 3M Commercial Graphics Warranties Brochure at 3Mgraphics.com, which gives the terms, additional limitations of the warranty, if any, and limitations of liability.

F. 3M™ MCS™ Warranty

Subject to Stipulations set forth in Section D., below

Finished graphics constructed with the materials specified and the exposure specified in the Warranty Period Table, Section F.(1), is eligible for the 3M™ MCS™ Warranty. For warranties for other exposures, see Section I.(1).

(1) Warranty Period Table for Finished Graphics in a Standard U.S. Vertical Exposure

Veh = Vehicle, RV, Straight Truck, Semi-Tractor and Semi-Trailer Graphics
OEM = Small format OEM labels and graphics
Signs = Indoor and Outdoor Sign Graphics

Warranty Period, in Years

Graphic Protection	No Printing			Ink Series 1900			Ink Series 9800			Ink Series 9800 Metallic		
	Veh	OEM	Signs	Veh	OEM	Signs	Veh	OEM	Signs	Veh	OEM	Signs
Films 3650-10, 3650-12												
1920DR	—	—	—	5	5	5	—	—	—	—	—	—
1930	—	—	—	2	2	2	—	—	—	—	—	—
V10402	—	—	—	6	5	6	—	—	—	—	—	—
9740i	—	—	—	6	5	6	7	5	7	7	5	7
9730UV	—	—	—	3	3	3	3	3	3	—	—	—
9800CL	—	—	—	—	—	—	5	5	5	5	5	5
None:				—	—	—				—	—	—
3650-10	8	5	7	—	—	—	—	—	2	—	—	—
3650-12	7	5	7	—	—	—	—	—	2	—	—	—
Film 3650-114												
1920DR	—	—	—	5	5	5	—	—	—	—	—	—
1930	—	—	—	2	3	3	—	—	—	—	—	—
V10402	—	—	—	5	5	5	—	—	—	—	—	—
9740i	—	—	—	5	5	5	5	5	5	5	5	5
9730UV	—	—	—	3	3	3	3	3	3	—	—	—
9800CL	—	—	—	—	—	—	5	5	5	5	5	5
None	5	5	5	—	—	—	—	—	—	—	—	—

G. 3M™ MCS™ Warranty Using Sericol Inks

Application: OEM graphics only
Film: 3650-10, 3650-12, 3650-114
Ink and Graphic Protection: Sericol Duracal UV Screen Print Ink and Clear
Warranty Period: 3 years in a vertical exposure

H. Legibility Warranty

For Fleet Graphics ONLY for Horizontal, Exposure and Selected Constructions

Applications subjected to maximum sunlight and environmental conditions used on rooftops of commercially-owned fleet vehicles where identification from the air is needed are warranted for legibility only for the following constructions. The graphic will change color, lose gloss and chalk.

Warranty Period, in Years

Films 3650-10, 3650-12		Horizontal Exposure	
Ink Series	Clear	U.S.	U.S. Desert Southwest
No printing	None	5	3
9800	9740i 9800CL	5	3

I. General Warranty Stipulations for 3M™ MCS™ Warranty

These stipulations apply to the 3M™ MCS™ Warranty. Also see the Graphics Market Center Warranty Brochure.

(1) Reduced Warranty Period for Other Graphic Exposures

For graphics oriented in a non-vertical or desert southwest, outdoor exposure, multiply the Warranty Period (in years) for your graphic construction as shown in the applicable Warranty Period Table, Section F.(1) by the percentage shown for the intended graphic exposure.

If the Graphic Exposure is	Use this Percentage of U.S. Vertical Exposure, Warranty Period	Warranty Period Calculation Examples
U.S. Non-vertical	50% (0.5)	0.5 x 5 years = 2.5 years
Desert Southwest Vertical	70% (0.7)	0.7 x 5 years= 3.5 years
Desert Southwest Non-vertical	35% (0.35)	0.35 x 5 years = 1.75 years
U.S. Horizontal	Warranted for legibility only. See Section 5.H. for more details.	

(2) Abrasion and Loss of Gloss

- Abrasion damage and loss of gloss are not covered by any 3M warranty. This is considered normal wear and tear. However, to help maintain the appearance of your graphic, use the recommended graphic protection whenever:
  - it is required for the construction and end use as shown in the Warranty Period tables.
  - the graphic is exposed to abrasive conditions, harsh cleaners or chemicals.
- Clear 1930 may haze, which is not warranted.

(3) Gasoline Vapor and Occasional Spills

For the best protection against staining for screen printed graphics subjected to gasoline vapors or occasional spills, use ink series 1900 with clear V10402.

(4) Application to Glass

3M accepts no liability for glass breakage when using this film for window graphics. See Instruction Bulletin 5.1 for details.

(5) Application Outside the U.S.

Contact the 3M organization for that country.

(6) Graphics Made with Components Not Sold or Recommended by 3M

The **3M™ MCS™ Warranty** does not cover finished graphics made with inks, film, graphic protection and/or application tapes that are not sold or recommended by 3M. The user is solely responsible for the graphic appearance, performance and durability of graphic constructions that include any other products.

6. Factors that Affect Graphic Performance Life

The actual performance life of a graphic depends on all of the following:

- correct combination of 3M-recommended graphics products.
- ink formulation.
- complete ink drying or curing.
- selection, condition and preparation of the substrate.
- surface texture.
- application methods.
- angle and direction of sun exposure.
- environmental conditions.
- cleaning or maintenance methods.

7. Graphics Manufacturing

⚠CAUTION Before using any equipment, always follow the manufacturers' instructions for safe operation.

A. Screen Printing

Formulations and processing conditions can affect ink durability. Refer to the Product and Instruction Bulletins for your ink for limitations and proper usage.

- The liner on film series 3650 is not printable. If you need a printable liner, contact Technical Service at 800-328-3908.
- Graphic protection can improve the appearance, performance and durability of your graphic. A clear coat also prevents chalking on unprinted colored films. Use standard screen printing methods to apply clear coats.

B. Cutting

The following are common cutting methods for this film. See Instruction Bulletin 4.1 for details.

(1) Methods

- Bandsawing
- Hot kiss cutting
- Drum-type electronic cutting
- Flat-bed electronic cutting
- Guillotine
- Hand cut
- Cold and hot steel-rule die cutting
- Knifeless™ Tape

(2) Size of Cut Text

The following minimum values for cutting text from film series 3650 are based on upper case Helvetica medium type. Weeding is much more difficult with smaller text.

Minimum stroke width: 0.25 inch (6.35 mm)
Minimum height: 3.0 inch (76.2 mm)
Minimum radius for end of stripe: 0.024 inch (0.6 mm)

C. Application Tapes

(1) When to Use Premasking Tape

- Use as an application aid to increase stiffness, and prevent stretching and damage during application.
- Use when little or no liner is exposed.

(2) When to Use Prespacing Tape

- Use to hold cut and weeded letters or graphics in registration after removing the film liner.
- Use to protect cut graphic parts from scratching or damage during application.
- Use when large amounts of liner are exposed.

(3) How to Select a Tape

Determine whether you want to premask the graphic or prespace the film elements. Then locate the graphic protection on your graphic in the table below, and use the corresponding tape. See Instruction Bulletin 4.3 for complete details.

EXAMPLE: If the film is protected by clear 9740i and you want to premask the film, use premasking tape SCPM-44X.

Select the tape based on what is on top of the graphic

Application Tape	Unprinted	1920DR, 1930	9740i 9730UV	9800 Ink Only	9800CL
Premasking SCPM-3	■	■	—	—	—
Prespacing SCPS-2	■	■	—	—	—
Premasking SCPM-44X	—	—	■	■	■
Prespacing SCPS-53X	—	—	■	■	■

— = This application tape is not recommended for the construction.

8. Application and Installation

A wet or dry application method may be used, EXCEPT on vehicles, which must be dry applied.

Refer to the 3M Related Literature section for a list of the Instruction Bulletins that may be needed to apply or install this film.

A. Pressure-Sensitive Adhesive

This film has a pressure-sensitive adhesive. It bonds to the surface even with light pressure and cannot be repositioned.

B. Edge Sealing

If an application requires edge sealing, use edge sealer 3950.

9. Maintenance

Use a cleaner designed for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without strong solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline.) See Instruction Bulletin 6.5.

Chalking on unprinted colored film can be washed off with normal graphic cleaning methods.

10. Removal

Film series 3650 is not a removable film. Removal requires a solvent-based or mechanical remover system. It may be very time consuming and may damage the substrate.

11. Shelf Life, Storage and Shipping

A. Shelf Life

Total shelf life: 3 years from the date of manufacture on the original box.
If you do process the film, do so within 2 years and apply within 1 year.
If you do not process the film, apply it within 3 years.

B. Storage Conditions

- 40° to 80°F (4° to 27°C)
- Out of sunlight
- Clean dry area
- Original container
- Bring the film to print room temperature before using

C. Shipping Finished Graphics

Flat (may be separated by paper), or rolled printed side out on 5 inch (13 cm) or larger core. This helps prevent the liner and, if used, the application tape from popping off.

12. Health and Safety

⚠ CAUTION

When handling any chemical products, read the manufacturers' container labels and the Material Safety Data Sheets (MSDS) for important health, safety and environmental information. To obtain MSDS sheets for 3M products go to 3M.com/MSDS, or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturers' instructions for safe operation.

13. 3M Related Literature

Before starting any job, be sure you have the most current Product and Instruction Bulletins.

The information in 3M Product and Instruction Bulletins is subject to change. Current Bulletins are available at 3Mgraphics.com. The following applicable Bulletins provide information and processes you need to properly make the graphics described in this Bulletin. Additional Bulletins may be needed as indicated in the 3M Related Literature section of other 3M components you use.

Bulletin types: PB = Product Bulletin; PB-IB = Product & Instruction Bulletin; IB = Instruction Bulletin

Subject	Type	Bulletin No.
3M™ Screen Printing Ink Series 1900 and Overprint Clear VI0402 - Screen printing with ink series 1900 - line color - Screen printing with ink series 1900 - 4-color	PB IB IB	1900 3.12 3.11
3M™ Screen Printing UV Ink Series 9800 - Screen printing with UV ink series 9800 - line color - Screen printing with UV ink series 9800 4-color	PB IB IB	9800 3.20 3.21
3M™ Screen Print UV Gloss Clear 9740i	PB-IB	UV Clears
Preparation for four color screen printing	IB	1.1
Design of graphics	IB	2.1
Using 3M application tapes; premasking and prespacing for films	IB	4.3
Application, substrate selection, preparation and substrate-specific application techniques	IB	5.1
Application, special applications and vehicles	IB	5.4
Application, general procedures for indoor and outdoor dry applications	IB	5.5
Storage, handling, maintenance, removal	IB	6.5
3M Commercial Graphics Warranty Brochure		

14. Bulletin Change Summary

Corrected adhesive color to clear for black film 3650-12. Clear 9740i is a direct replacement for clears 9720i and 9720UV. Added flammability information on ASTM E84. This product complies with UL 969 - Standard for Marking and Labeling Systems. Added Knifeless tape as a recommended cutting method. Updated overall bulletin format including adding new Performance Overview section and revising the Warranty Information section. Warranted Durability is now referred to as Warranty Period.

3M

Commercial Graphics
3M Center, Building 220-12E-04
St. Paul, MN 55144 USA
General & Technical
1-800-328-3908
Fax 1-651-736-4233

3M Canada
PO Box 5757
London, Ontario
Canada N6A 4T1
General 1-800-265-1840
Fax 519-452-6245

3M México S.A. de C.V.
Av. Santa Fe No. 55
Col. Santa Fe, Del. Alvaro Obregón
México D.F. 01210
General 5255-5270-0400
Fax 5255-5270-2277

3M Puerto Rico, Inc.
350 Chardon Avenue
Suite 1100
San Juan, PR 00918
General 787-620-3000
Fax 787-620-3018

www.3Mgraphics.com

Product Bulletin 3690
Release F, Effective March 2006
See Bulletin Change Summary on last page

Scotchcal™
Graphic Film Series 3690

For Screen Printing Only

Description

3M™ Scotchcal™ Graphic Film Series 3690 is a premium 2-mil, screen printable film with an aggressive, pressure sensitive adhesive that has good adhesion to sand cast, moderately-rough surfaces and some low surface energy materials. Designed with a gray adhesive for good hiding power, this long–term permanent film withstands severe weather and handling conditions encountered by commercial and industrial graphics.

Recommended Types of Graphics and End Uses

When constructed and used as described in this bulletin, these types of graphics and end uses may be warranted by the 3M™ MCS™ Warranty. Please read the entire bulletin for details.

- Use for multicolor graphics including labels, emblems, and striping
- Use for original equipment manufacturer's decorative and identification graphics, cautionary, safety and vandal-resistant labeling

Limitations of End Uses

We do not normally warrant other applications, but please contact us to discuss your needs or let us suggest other 3M products.

Unsuitable End Uses for this Film

- Applications to corrugated surfaces
- Graphics regularly subjected to gasoline vapors or spills
- Graphics made for automotive Original Equipment Manufacturers (OEM); contact 3M Automotive Division at 1-800-328-1684 for alternatives.

Compatible Products for 3M™ MCS™ Warranted Graphics

3M Inks

- 3M™ Screen Printing Ink Series 1900
  l*ine color and four color*
- 3M™ Screen Printing UV Ink Series 9800
  line color and four color

3M Graphic Protection Options

- 3M™ Screen Print Gloss Clear 1920DR
- 3M™ Screen Print Low Gloss Clear 1930
- 3M™ Screen Print Gloss Clear 9720UV
- 3M™ Screen Print Low Gloss Clear 9730UV
- 3M™ Screen Print UV Gloss Clear 9800CL

OEM Inks and Clears

- Sericol™ Duracal™ UV Screen Print Inks
- Sericol™ Duracal™ Overprint Clear
  (warranted for OEM applications only)

Note: See page 4 for how to order Duracal inks.

Other Products

- 3M™ Premasking Tape SCPM-3
- 3M™ Premasking Tape SCPM-44X
- 3M™ Prespacing Tape SCPS-2
- 3M™ Prespacing Tape SCPS-53X

Note: For the full product names of the 3M products listed on this page, please see page 1.

Characteristics

All values given are typical for unprocessed film unless noted otherwise and are not for use in specifications. Processing film may change certain values. Please contact the Technical Service helpline at 1-800-328-3908 if you need more detailed information.

Physical Characteristics

Characteristic	Description
Material	Vinyl
Color	White: 3690-10, 3690LF-10 Black: 3690-12, 3690LF-12
Thickness	**Without adhesive:** 2 mils (0.05 mm) **With adhesive:** 3 to 4 mils (0.08 to 0.10 mm)
Adhesive type	Pressure sensitive
Adhesive color	Gray
Liner	**3690-10, 3690-12:** white kraft paper **3690LF-10, 3690LF-12:** Polyethylene-coated layflat paper
Tensile strength *(minimum)*	5 pound/inch at 73°F (0.9 kg/cm at 23°C)
Adhesion *24 hours after application* ***Note:** The adhesive becomes more aggressive as the surface temperature increases.*	**ABS:** 5 pounds/inch (0.9 kg/cm) **Acrylic enamel:** 5 pounds/inch (0.9 kg/cm) **Aluminum, anodized**: 6 pounds/inch (1.1 kg/cm) **Aluminum, etched:** 5 pounds/inch (0.9 kg/cm) **Chrome:** 5 pounds/inch (0.9 kg/cm) **Fiberglass:** 5 pounds/inch (0.9 kg/cm) **Powder coat paint:** 3-6 pounds/inch (0.5-1.1 kg/cm) v*alue can vary greatly; contact your 3M representative to arrange for 3M to test your substrate*
Chemical resistance	Resists mild acids, mild alkalis, and salts. Excellent resistance to water *(this does not include immersion)*

Application Characteristics

Characteristic	Description
Finished graphic application recommendation	**Surface type:** Flat or moderate compound curves, with and without rivets **Substrate type:** Most rigid plastics (including polyethylene and polypropylene), etched and anodized aluminum, chrome, fiberglass and paint[1] **Application temperature:** 40° to 90°F (4° to 32°C) *air and substrate* [2]
Applied film shrinkage	0.047 inch (1.2 mm)
Finished graphic exposure temperature	-65° to +225°F (-54° to +107°C)
Graphic removal	Permanent

Warranty Information

Graphic Performance Life

The graphic performance life is based on field experience and exposure tests conducted throughout the United States. When the graphics are processed and used according to 3M recommendations, they should have the performance life shown in the chart below.

The actual performance depends on the:

- Correct combination of 3M–recommended products
- Ink formulation (screen printing)
- Adequate ink drying or UV curing
- Selection and preparation of the substrate
- Surface texture
- Application methods
- Angle and direction of sun exposure
- Environmental conditions
- Cleaning or maintenance methods

Continued on the next page

Note: For the full product names of the 3M products listed on this page, please see page 1.

3M™ MCS™ Warranted Graphic Constructions

The warranty given in the Product Bulletin that is current at the time you purchased the film is the one that 3M will honor.

Warranted Durability		
		U.S. Vertical Exposure *(in years)*
Ink Series	**Clear**	**Labels, Emblems, Striping**
Unprinted	None	7
1900 *line color*	1920DR 1930	5 2 *may haze*
1900 *4–color*	9720UV 9730UV	5 3
9800 *line color*	None 9720UV 9730UV 9800CL	0 5 3 5
9800 *4–color*	9720UV 9800CL	5 5
Duracal UV Ink *line color*	Duracal Clear	5

Note: Sericol Duracal UV Inks are warranted for Original Equipment Manufacturer (OEM) applications only.

Warranty Notes

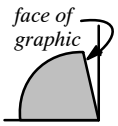
Warranty Exceptions

Unprinted film 3690-10 has a tendency to chalk in exterior applications. Film that cannot be cleaned must be printed with a recommended 3M screen print clear. The warranty is the same as in the table above for printed graphics.

Graphic Exposure Definition

Vertical Exposure

The face of the graphic is ± 10° from vertical.



Non-Vertical Exposure

The face of the graphic is greater than 10° from vertical.

How to Determine U.S. Non-Vertical and Desert Southwest Warranties

All other exterior warranties are based on a percentage of the U.S. vertical warranties given in the Warranted Durability Table. The calculations for determining these warranties are given below. A "construction" is the base film, ink and graphic protection, if required. The examples are based on a U.S. vertical warranty of 5 years.

- **Warranty for U.S. Non-Vertical Exposure**

  50% (0.5) of the U.S. vertical warranty for your construction

  Example: 0.5 x 5 years = 2.5 years

- **Warranty for U.S. Desert Southwest Exposure**

  For graphics exposed to solar energy more than half of the time in Arizona, New Mexico and the desert areas of California, Nevada, Utah and Texas. A detailed map is available upon request.

  - **U.S. Vertical Desert Southwest**

    70% (0.7) of the U.S. vertical warranty for your construction

    Example: 0.7 x 5 years = 3.5 years

  - **U.S. Non-Vertical Desert Southwest**

    35% (0.35) of the U.S. vertical warranty for your construction

    Example: 0.35 x 5 years = 1.75 years

Application Outside the U.S.

Contact the 3M organization for that country.

Warranty and Limited Remedy

The following is made in lieu of all other express or implied warranties, including any implied warranty of ***merchantability*** *or fitness for a particular purpose:* 3M graphics materials are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. 3M will replace or refund the price of any 3M materials that do not meet this warranty within the specified time periods. See the worldwide 3M™ MCS™ Warranty (www.Scotchprint.com or Fax-on-Demand), which gives the terms and limitations of the warranty.

These remedies are exclusive. In no case shall 3M be liable for any direct, indirect, or consequential damages, including any labor or non-3M materials charges.

Note: For the full product names of the 3M products listed on this page, please see page 1.

Screen Printing

Formulations and processing conditions can affect ink durability. Refer to the Product and Instruction Bulletins for your ink for limitations and proper usage.

How to Order Sericol Inks

Sericol's Duracal inks can be obtained through their distributor network. Please refer to this web site for details: http://www.sericol.com/Distributors/distribFR.htm. You can also contact Sericol at: Sericol Inc. Corporate Office 1101 W. Cambridge Drive, Kansas City, KS 66103 Tel: 913-342-4060, Fax: 913-342-4752

Cutting

These are the common cutting methods for film series 3690.

- Band sawing
- Hand cut
- Guillotine
- Cold and hot steel-rule die cutting
- Hot kiss cutting
- Flat-bed electronic cutting
- Drum-type electronic cutting

Application Tape

The type of application tape used depends on the type of graphic produced and the ink or screen print clear that was applied last.

- Use a premasking tape if very little of the liner is exposed.
- Use a prespacing tape if the graphic has large amounts of exposed liner.

Clear	Premasking Tape	Prespacing Tape
Unprinted film	SCPM-3	SCPS-2
1920DR 1930	SCPM-3	SCPS-2
9720UV 9730UV 9800 (no clear) 9800CL	SCPM-44X	SCPS-53X

Application

Refer to the **3M Related Literature** section, located at the end of this bulletin, for a list of the Instruction Bulletins that may be needed to apply or install this film.

Adhesive

This film has a pressure–sensitive adhesive that adheres to the substrate on contact. It is not positionable. Refer to Instruction Bulletin 5.5.

Application Method

Use a dry application method. Do not use a detergent and water or a commercial application liquid to position the graphic.

Maintenance and Cleaning

Use a mild cleaner such as the kind used for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without strong solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline). See Instruction Bulletin 6.5.

Removal

This film is not removable. A solvent-based remover system may be needed.

Shelf Life, Storage, and Shipping

Activity	Recommendation
Shelf life	**Total shelf life: 2 years** Up to 2 years unprocessed, ***OR*** process within 1 year ***and*** apply within 1 year of processing
Storage conditions	• 80°F (27°C) maximum • Out of sunlight • Clean dry area • Original container
Shipping finished graphics	Flat, or rolled printed side out on 5 inch (13 cm) or larger core; this helps prevent the liner and premasking tape from wrinkling or popping off

Health and Safety

⚠ Caution

When handling any chemical products, read the manufacturers' container labels and the Material Safety Data Sheets (MSDS) for important health, safety and environmental information.

To obtain MSDS sheets for 3M products:

- By fax, call 1-800-364-0768 in the US and Canada or 1-650-556-8417 for all other locations.
- Electronically, visit us at http://www.3m.com/msds.
- By mail, or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturers' instructions for safe operation.

Attention:
Authorized Graphics Manufacturers

Visit our password-protected website for exclusive product information, profiles and services. Certain restrictions apply.

1. Go to www.scotchprint.com.
2. Select a country.
3. Click *Login* on upper left side of screen.
4. Click Register.
5. Enter authorization code: **CGD_SGN.**
6. Complete the information and submit.
   An e−mail will be sent when your authorization is completed.

3M Related Literature

Before starting any job, be sure you have the most current product and instruction bulletins.

The information in 3M bulletins is subject to change. Current bulletins, as well as a list of all bulletins updated within the last three months, are available at www.scotchprint.com or through our Fax−on−Demand system. Any warranty, if offered, is based on information in the bulletin that was current at the time you purchased the 3M products. The following bulletins provide the information and processes you need to properly make the graphics described in this bulletin.

Fax−on−Demand phone numbers:
United States or Canada: 1-800-364-0768
International: 1-651-732-6506

Subject	Bulletin No.	FOD No.
Product Bulletins		
3M™ Screen Printing Ink Series 1900	1900	2501
3M™ Screen Printing Ink Series 9700UV	9700	2507
3M™ Screen Printing UV Ink Series 9800	9800	2513
Instruction Bulletins		
Design of graphics	2.1	5501
Screen printing with ink series 1900 - line color - 4-color	 3.11 3.12	 6011 6012
Screen printing with UV ink series 9800 - line color - 4-color	 3.20 3.21	 6020 6021
Screen printing with ink series 9700UV	3.4	6004
Scoring and cutting	4.1	6501
Using 3M application tapes; premasking and prespacing for films	4.3	6503
Application, substrate selection, preparation and substrate-specific application techniques	5.1	7001
Application, special applications and vehicles	5.4	7004
Application, general procedures for interior and exterior dry applications	5.5	7005
Storage, handling, maintenance, removal	6.5	7505
Warranties		
Worldwide 3M™ MCS™ Warranty		9503

Bulletin Change Summary

Ink series 9700UV has been replaced by UV ink series 9800 with the same warranty. Other changes are marked by a black bar in the margin.

3M

Graphics Market Center
3M Center, Building 220-12E-04
PO Box 33220
St. Paul, MN 55144-3220 USA
General Info. 1-800-374-6772
Technical Info. 1-800-328-3908
Fax 1-651-736-4233

3M Canada
P.O. Box 5757
London, Ontario
Canada N6A 4T1
1-800-265-1840
Fax 519-452-6245

3M México, S.A. de C.V.
Av. Santa Fe No. 55
Col. Santa Fe, Del. Alvaro Obregón
México, D.F. 01210
52-55-52-70-04-00
Fax 52-55-52-70-22-77

3M Puerto Rico, Inc.
Puerto Rico Industrial Park
P.O. Box 100
Carolina, PR 00986-0100
787-620-3000
Fax 787-750-3035

Fax-on-Demand 1-800-364-0768 US/Canada or 1-651-732-6506 International
Fax-on-Demand document: 1512
www.scotchprint.com

Preclear Reflective License Plate Sheeting

With Ensure™ Image and Optional Ensure™ Virtual Security Thread
For Use on Multi-Year License Plates
Series 4770E/4770T

Product Bulletin 4770E/4770T **May 2014**

Replaces PB 4770E/4770T dated January 2013

Description

3M™ Preclear Reflective License Plate Sheeting Series 4770E/4770T is a durable, all-weather, retroreflective sheeting consisting of lens elements enclosed within a transparent resin, designed for use in the fabrication of multi-year reflective license plates. Plates can be embossed and roll coated with either transparent or opaque roll coating inks to produce attractive license plates which function 24 hours a day to enhance nighttime safety and the legibility of the vehicle identification system. Series 4770E/4770T sheeting appears similar during the day and at night (when viewed by reflected light) and is highly reflective when viewed both head-on and at wide entrance angles.

The backside of the reflective sheeting is pre-coated with a pressure sensitive adhesive, protected by a removable liner, for application to license plate substrates.

Series 4770E/4770T sheeting is available with personalized graphic designs which offer a unique opportunity to promote a country, state or national attraction, event or image while continuing to provide the motorist with the safety aspects of fully reflective license plates. Additional stretch and registry control equipment is required to process graphic printed sheetings.

3M sheetings, processing materials and equipment provide flexibility in the design of a license plate system, specific to the desires and requirements of plate issue relative to color, reflectivity, durability, design and plate manufacture.

3M™ Ensure™ Directional Image

Series 4770E/4770T sheeting with 3M™ Ensure™ Image contains directional positive identification images or marks that are an integral part of the sheeting and are visible only within a specific viewing angle range. The marks are extremely difficult to counterfeit and facilitate visual examination of the finished license plates for specified purposes of:

- Inventory control.
- Production traceability.
- Identification of year of manufacture.
- Identification of sheeting manufacturer.
- Positive field verification of license plate authenticity.

The Ensure image may be a custom design mutually agreed upon by the purchaser and 3M. The Ensure image size and spacing depends on the width of the sheeting purchased. Each license plate will have a minimum of two images visible on the finished plate.

Orientation

Directional identification marks allow for easy visual verification of the license plate authenticity as follows:

A. The centermost mark on the plate will be visible to a viewer standing directly in front of the plate at a distance of 4-8 feet (1.2 - 2.5 m). This represents an angle of 30° above perpendicular to the plate.

B. The centermost mark on the plate shall not be visible to a viewer:

1. Standing at a distance of either 2 feet (.6 m) or 20 feet (6.1 m) directly in front of the plate.
2. When the viewer has stepped from the head-on viewing position to either side thus forming an angle greater than 45° to the plate.

The directional identification marks will be visible in either diffuse daylight or by retroreflected light at night. The marks will not alter the color of the sheeting, reduce the sheeting brightness below the minimum specified levels, or interfere with appearance and legibility of finished license plates. In diffuse daylight, the directional identification marks are equally visible in all standard colors.

The marks cannot be removed by chemical or physical means from the sheeting or the finished license plate without visibly damaging the reflective sheeting.

Optional 3M™ Ensure™ Virtual Security Thread

Series 4770T sheeting with 3M™ Ensure™ Virtual Security Thread contains a second mark that runs vertically or horizontally through standard vehicle registration plates for purposes of security and anti-counterfeiting. The virtual security thread is buried beneath the surface of the sheeting and consists of two sinusoidal waves where one wave appears to float above and one wave appears to float below the Ensure image in the retroreflective sheeting. The virtual security thread is durable for the service life of the license plate.

The virtual security thread is visible in the unprinted areas of the plate from within a standard police vehicle under high beam headlight illumination, as well as outside of the vehicle, on a license plate properly affixed to the vehicle's designated mounting area, from an approximate distance of 0 to 50 feet (0 to 15 meters) at a head-on viewing angle. The two sinusoidal wave images are visibly distinct from an approximate distance of 0 to 20 feet (0 to 6 meters). The virtual security thread is not visible when viewed from an angle greater than 45 degrees from the head-on viewing position.

The virtual security thread is verifiable under both diffuse daylight and retroreflected light at night. The virtual security thread does not alter the color of the sheeting, reduce sheeting brightness below the minimum specified brightness levels, or interfere with appearance and legibility of finished license plates. In diffuse daylight the virtual security thread is visible in all standard sheeting colors.

A. Reflectivity

The minimum reflectivity values of 3M sheeting series 4770E/4770T are shown in Table A.

Table A

Minimum Coefficient of Retroreflection

Candlepower per foot candle per Square Foot

Candelas per Lux per Square Meter

(0.2° Observation Angle[1])

Sheeting Color		Entrance Angle[2]	
		-4°	40°
White	4770E/4770T	50	16
Yellow	4771E/4771T	25	10
Red	4772E/4772T	9	3
Gold	4773E/4773T	25	10
Orange	4774E/4774T	25	10
Lt. Blue	4776E/4776T	18	7
Lt. Green	4777E/4777T	18	7
Lemon Yellow	4781E/4781T	25	10
Pastel Colors			
Salmon	PC751E/PC751T	35	12
Silver Gray	PC752E/PC752T	35	12
Sand	PC753E/PC753T	35	12
Sunflower	PC754E/PC754T	35	12
Lime Yellow	PC755E/PC755T	35	12
Sea Green	PC756E/PC756T	35	12
Sky Blue	PC757E/PC757T	35	12
Straw	PC758E/PC758T	35	12
Chamois	PC759E/PC759T	35	12

[1]Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[2]Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

All measurements shall be conducted in accordance with ASTM E810, "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting."

Measurements on reflective sheeting with a preprinted graphic design shall be taken in an unprinted sheeting area.

The reflectivity of the flat area of the same test plate, totally wet by rain, will not be less than 90% of the values specified above. Wet performance measurements shall be conducted in accordance with ASTM E810. Contact your 3M Technical Representative for wet performance measurement test set-up.

To measure the reflectivity values of applied 3M sheeting, prepare test plates as follows:

- Test plates of the same size and format as the actual issue must be produced of the same materials, on the same equipment, and by the same general process of metal cleaning, laminating, embossing or debossing and roll coating as production plates.
- The plates must be designed to have a minimum of 36 square inches (230 sq. cm) of flat area, in one section of the plate to facilitate photometric testing.
- All test plates should be conditioned for 24 hours at 72°F ± 5°C (22°C ± 1°C) and 50 ± 5% R.H. prior to testing.
- Each plate must be thoroughly hand washed (see Cleaning) prior to testing.

B. Adhesive
Test plates as prepared above will resist peeling, scuffing and marring from recommended application surfaces, during normal use handling, and resist shocking off when jabbed with a spatula at -10°F (-23°C).

Prior to application, the protective paper liner can be removed from the adhesive by peeling without soaking in water or other solvents. The liner can be removed after accelerated storage for 4 hours at 150°F (65°C) under a weight of 2.5 pounds per square inch (0.18 kg/cm^2).

Fabrication of Reflective License Plates

Note: *For recommended manufacturing procedures used in the fabrication of license plates refer to Information Folder 9.8.*

A. Substrates
The pre-coated adhesive will form a permanent bond to the surface of clean, chemically treated or conversion coated aluminum substrates normally used in the manufacture of license plates and as recommended by 3M. Contact your 3M Technical Service Representative for specific substrate recommendations.

B. Application
3M sheeting is designed for application to clean flat coil or sheet stock by continuous squeeze roll application.

A minimum of 48 hours storage after application of sheeting is recommended before embossing or debossing. Laminated blanks must be stored on edge and used within one year after date of receipt of the 3M sheeting for best embossing results.

C. Embossing and Debossing
3M reflective sheeting as applied to flat metal is sufficiently flexible to permit the embossing or debossing requirements of most conventional license plate designs.

3M reflective sheeting may be embossed or debossed up to 2mm or .080 inches with standard embossing equipment and dies used for license plate production. Minimum embossing temperature is 70°F (21°C).

To enhance the printability and quality of the embossed or debossed license plates, they must be roll coated within 24 hours.

D. Color Processing
The legend is applied to embossed or debossed plates by roller coating with the following 3M recommended high quality transparent or opaque inks and foils. **Note:** *Care should be taken in choosing color combinations to ensure attractiveness and maximum legibility. This is especially true with graphic design sheetings. To assure suitable contrast for maximum legibility and safety, 3M recommends use of dark color roll coated characters on a white or yellow reflective sheeting background.*

E. Oven Dried Inks:
3M™ Series 4800 Opaque
3M™ Series 4850 Opaque
3M™ Series 4900 Transparent
3M™ Series 4950 Transparent

Contact your 3M Technical Representative for assistance with oven drying conditions. Cool the license plates to room temperature before packaging.

F. Dry Roll Coat Foils
Note: *For recommended dry roller coating practices, refer to Product Bulletin HSF100/200. Use series HSF100 or 200 dry roller coat foils. Contact your 3M Technical Service Representative for additional information on dry roller coating foils.*

Cleaning

For maximum service, do not use abrasive, or chemically concentrated harsh cleaners. Use the same care as is used in cleaning the paint surface on the vehicle. The license plate surface should be cleaned of normal use dirt accumulation by washing with a mild detergent and water using a soft bristle brush or cloth. Following cleaning, the plate should be thoroughly rinsed with water.

To remove tar, oil, or road film, cautious use of mild solvents such as mineral spirits, turpentine, or kerosene may be employed. Use of aromatic solvents and ketones or solvent mixtures containing them should be avoided.

Storage

Sheeting and roll coat inks must be stored in their original package in a cool, dry area and should be used within one year after date of receipt.

General Characteristics and Packaging

The reflective sheeting as supplied will be of good appearance, free from ragged edges and cracks, and packaged according to commercial standards. The sheeting must be spliced for continuous roll application. Additional sheeting is supplied to compensate for splices.

Specifications

The information contained herein on 3M reflective sheeting Series 4770E/4770T is considered to describe typical minimum requirements for an effective reflective license plate material. As such, the information may be incorporated into a product purchase specification to be used in conjunction with a specification for finished retroreflective license plates.

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.

Warranty

3M warrants that 3M™ Preclear Reflective License Plate Sheeting Series 4770E/4770T (with Ensure™ Warranty Mark) sold by 3M for fabrication of reflective safety plates in the United States, Mexico and Canada will remain effective for its intended use and retain a coefficient of retroreflection of at least nine (9) candlepower per foot candle per plate[3] for the number of years indicated in the following table and subject to the following provisions:

Sheeting Color	Years
White	5
Pastel Colors	5
Yellow	5
Lemon Yellow	5
Gold	3
Orange	3
Blue	2
Green	2

Notes: *All measurements are at .2 degrees observation angle and -4 degrees entrance angle. All measurements shall be made after cleaning the plate according to 3M recommendations and in accordance with ASTM E 810 "Standard Test Method of Coefficient of Retroreflective Sheeting," except that the coefficient of luminous intensity shall be determined in accordance with ASTM E 808-01 Para. 3.2.2 and ASTM E 809-02 Para. 12.3.*

Graphic preprinted transparent colored areas are warranted for the same number of years as the background sheeting as stated above.

If 3M preclear reflective license plate sheeting is applied to 3M-approved substrate materials in accordance with all 3M application procedures found in 3M's product bulletins, information folders, and technical memos (which will be furnished to the agency upon request), including the appropriate use of 3M matched component systems, roll coat inks, and recommended application equipment; and

If at any time during the period specified in the table above: a) plates show fading, cracking, blistering or peeling which will significantly impair the intended visibility or legibility of the plate; or b) a one-half of one percent sample of clean, rear plates provided from a given production run (which is identified by the integral Ensure warranty mark) reveals that 10 percent or more of that sample fails to retain at least nine (9) candlepower per foot candle per plate[3] (0.84 candelas per lux per plate) as defined herein;

3M will, at its expense, replace all of the plates manufactured from that specific lot of material, up to a maximum of $5.00 per plate. Reimbursement to the using agency will be in dollars and/or materials, as determined by the needs of the using agency.

[3]Graphic printed reflective plates may not meet this requirement as large graphic printed areas can affect the reflectivity values of the finished license plates.

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M preclear reflective license late sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of roll coat pastes or overlay films and sheetings not made by 3M; exposure to excessively high oven temperatures; use of a reflective sheeting applicator, stretch control mechanism, brake table or corresponding registry feed controls not provided and installed by 3M; failure of plate substrate; exposure to chemicals, abrasion, or damage from fasteners used to mount the plate; collisions, vandalism or malicious mischief.

Replacement sheeting will carry the unexpired warranty of the sheeting it replaces.

Claims made under this warranty will be honored only if the plates have been marked with the Ensure warranty mark so as to be traceable to the specific 3M production run numbers from which the material originated.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is premitted to verify the cause of the failure.

Limitation and Liability

3M's liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

FOR INFORMATION OR ASSISTANCE CALL:
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Roll Coat Inks

Series 4800/4900

Product Bulletin 4800/4900 **April 2014**

Replaces PB 4800/4900 dated May 2010

Description

3M™ Roll Coat Inks are used in conjunction with 3M™ Reflective License Plate Sheeting to produce fully reflective vehicle registration plates for multi-year use. When processed according to the manufacturer's recommendations, 3M roll coat inks will last for the intended life of the registration plate. The inks are supplied in transparent colors as Series 4900 and opaque colors as Series 4800. They are intended for use on 3M™ License Plate Sheeting Series 3570/3750 and Series 4550/4770/4780.

Application

Transparent and opaque roll coat inks are applied to the embossed or debossed license plate by roller coating with a high quality roller coating machine. When roll coating license plates with the depressed style rim, hold down rollers are recommended to prevent the plate background from being painted.

Roll coat inks may be thinned with 3M 4904 or 4905 Thinner for ease of coating on the machine. DO NOT THIN MORE THAN 10%. Thinning by more than 10% may affect the ability to meet local volatile organic content (VOC) emission levels.

Drying

Drying is best accomplished when baked for a minimum of 20 minutes at 225°F in a convection oven with good air circulation.

Contact your 3M Technical Representative for assistance in establishing time and temperature settings.

Colors

	Transparent Inks	Opaque Inks
Blue	4901	4806
Dark Blue	-	4811
Red	4902	4802
Light Red	4909	-
Green	4903	4807
Dark Green	4913	4803
Cranberry	4906	-
Blue Violet	-	4808
Maroon	4914	-
Orange	-	4814
Purple	-	4815
Brown	4900	4816
Violet	-	4801
Black	-	4805
White	-	4812
Clear Toner	4911	-
Yellow Toner	4912	-
Yellow	-	4809

Health and Safety

Read all health and hazard, precautionary, and first aid statements found in the Materials Safety Data Sheet, and/or product label of chemicals prior to handling or use. Consult local regulations and authorities for possible restrictions on product VOC and/or VOC emissions.

Storage

3M roll coat inks should be stored at general warehouse storage (16ºC/60ºF to 27ºC/80ºF). Inks have a shelf life of 12 months from customer receipt.

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3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice
All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties,or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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Please recycle.

Roll Coat Inks

Series 4850/4950

Product Bulletin 4850/4950 **April 2014**

Replaces PB 4850/4950 dated May 2010

Description

3M™ Roll Coat Inks are used with 3M™ Reflective License Plate Sheetings to produce fully reflective vehicle registration plates for multi-year use. When processed according to the manufacturer's recommendations, 3M roll coat inks will last for the intended life of the registration plate. The inks are supplied in transparent colors as Series 4950 and opaque colors as Series 4850. They are intended for use on 3M™ License Plate Sheeting Series 4550/4770/4780, Series 4750, and Series 3570/3750.

Application

Transparent and opaque roll coat inks are applied to the embossed or debossed license plate by roller coating with a high quality roller coating machine. When roll coating license plates with the depressed style rim, hold down rollers are recommended to prevent the plate background from being painted. Roll coat inks may be thinned with 3M 4954 Thinner for ease of coating on the machine. DO NOT THIN MORE THAN 10%. 3M T11A Thinner has proven to be an adequate cleaning solvent. Other locally available solvents for clean up should be tested to avoid damage to the coating rolls.

Drying

Drying is best accomplished when baked for a minimum of 20 minutes at 225°F in a convection oven with good air circulation.

Contact your 3M Technical Representative for assistance in establishing time and temperature settings.

Infrared drying has been satisfactory in some license plate shops. Exact oven configurations, time and settings are the responsibility of the license plate shop; however,all forms of drying must have sufficient exhaust to adequately remove all solvents during the drying process. Typical minimum drying conditions would be:

Minimum exposure time: 5 minutes

Maximum surface temperature: 300°F.

Colors

	Transparent Inks	Opaque Inks
Blue	4956	4856
Dark Blue	4959	4855
Red	4952	4853
Light Red	4951	–
Green	4957	4854
Dark Green	4955	–
Cranberry	4958	–
Purple	–	4857
Black	–	4852
White	–	4850

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.

Storage

3M roll coat inks should be stored at general warehouse storage (16ºC/60ºF to 27ºC/80ºF). The inks have a shelf life of 12 months from customer receipt.

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3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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